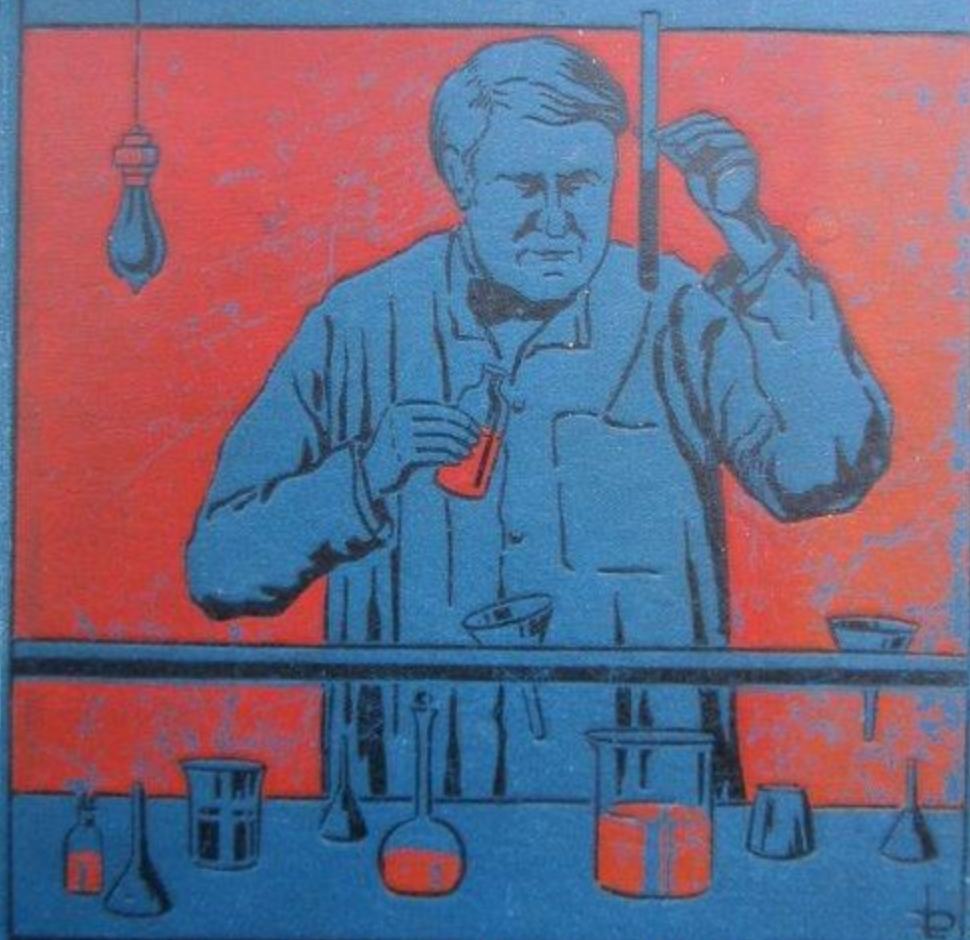


THE STORY OF EDISON



• BY FRANK MUNDELL
MEN OF FAME SERIES •

PORTSMOUTH
Education Committee.

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THE STORY OF EDISON



EDISON AT WORK.



THE STORY OF EDISON

AND THE
WONDERS OF
ELECTRICITY

BY

FRANK MUNDELL

AUTHOR OF

"INTO THE UNKNOWN WEST,"
"STORIES OF THE LIFEBOAT,"
"STORIES OF THE ROYAL
HUMANE SOCIETY," ETC., ETC.

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THE
STORY OF EDISON
AND THE
WONDERS OF ELECTRICITY.

CHAPTER I.

A WIDE-AWAKE BOY.

SOME years ago a great civil war broke out in the United States of America. The North did not agree with the South about slavery, and an attempt was made to check, if not to abolish, the evil. The Southern States said that they had a right to do as they pleased, and that the slaves were as much their property as their houses and lands. The Northern States denied this right, so the "seven cotton States," in which most of the labour was performed by slaves, declared themselves independent. Then followed the great war, the country was deluged in blood, the South was defeated, slavery was abolished, and the Union was preserved.

When the struggle was going on there was a great demand for information from the seat of the war. And after a great battle, the desire to know the result, and to obtain a list of the killed and wounded, rose to fever height.

At this time there was a train boy on the Grand Trunk Railway, between Detroit and Port Huron. His business was to sell newspapers, fruits, and other articles to the passengers, and persons at the wayside stations. His bright and cheery manner won him many friends, and enabled him to carry on a brisk trade, which yielded about one hundred pounds a year clear profit.



AN AMERICAN RAILWAY TRAIN.

The chief part of his business was selling newspapers, and in this he had to act cautiously, for the margin on which he worked was very small. He could

not afford to have unsold papers left on his hands, yet it was very important not to run short, as he travelled with the train and could not get a further supply.

To guide him in his daily purchases, he saw that it was necessary to obtain a knowledge of the contents of the paper before it was issued. He had not time to do this after he received it, for then every moment was of value in getting the paper sold. So he made friends with a compositor in the printing office of the *Detroit Free Press*, and persuaded this man to let him see a proof of the paper. In this way he learned when there was any news of more than usual interest, and gave his orders accordingly.

One day, in 1862, the compositor showed the lad the proof containing an account of the two days' battle of Shiloh, which General Grant had won at Pittsburg Landing. The engagement was described as having been very severe, and the losses, in killed and wounded, were put down at between fifty and sixty thousand.

The ready-witted lad saw at once the great value of the information. But how could he turn it to account? Here was the chance of making in one day what to him would be a small fortune. A sudden idea struck him, and he acted on it at once.

He knew the telegraph operator at Detroit, so running into the telegraph office, he made the man the following proposal :

"If you," said the lad, "will wire to each of the principal stations on the route, and ask the station-master to chalk on the black bulletin board, used for announcing the times of the arrival and departure of the trains, the news of the great battle, with its accompanying slaughter, I will supply you with *Harper's Weekly*, *Harper's Monthly*, and a daily paper free, for six months."

The man at once agreed to the proposal. Then the lad had to think of some means of getting the papers he should require, to supply the demand he expected his telegram would create. He had not enough cash to buy anything like the number he required, and the superintendent of the office bluntly refused to let him have a thousand papers on trust.

Feeling desperate, and unwilling to lose such a grand opportunity, he determined on a bold stroke. Upstairs he went, and, marching into the office of the editor, he briefly told his story, who he was, what he had done, and what he wanted. This time he asked for fifteen hundred papers. The tall, thin, dark-eyed man stared at him for a moment, and then wrote something on a slip of paper.

"Take that downstairs," he said, "and you will get what you want."

The lad did so. "And then," says he, "I felt happier than I have ever felt since."

Before the train started, the lad managed to get a word with the engine driver, who promised to allow him a few minutes longer than usual at each station. Then they started. And now we will describe the sale of the papers in his own words.

"At Utica, the first station out from Detroit, and about twelve miles distant, I usually sold two papers, our customary charge being five cents each (2½d.) As we approached the station on this day, I put my head out to look forward, and thought I saw an excursion party. I had half-a-dozen papers in my hand. As we came nearer, and the people caught sight of me, they commenced to gesticulate and shout, and it suddenly occurred to me that they wanted papers. I rushed back into the car, grabbed an armful, and when I got upon the platform I sold forty.

"Mount Clemens was the next station. When it came in sight I thought there was a riot. The platform was crowded with a howling mob, and when the tones became intelligible, I realised that they were after news of Pittsburg Landing, so I raised the price of the papers to ten cents (5d.), and sold a hundred and fifty, where I had never before disposed of more than a dozen.

"As other stations were reached, these scenes were repeated; but the climax came when we got to Port

Huron. The station there was a mile from the town. When the train stopped, I shouldered my bundle and started for the city. When I got less than half way I met a crowd hurrying towards the station. I thought I knew what they were after, so I stopped in front of a church, where a prayer meeting was being held, raised the price to twenty-five cents (1s. 0½d.) a copy, and commenced to take in a young fortune. In two minutes the prayer meeting was adjourned, the members came rushing out, and if the way coin was produced is any indication, I should say that the deacons hadn't passed the plate before I came along.

"You can understand why it struck me that the telegraph was the best thing going, for it was the telegraphic notices on the boards that had done the trick. I determined at once to become a telegraph operator."

Now there is nothing novel or particularly ingenious in a newspaper boy taking advantage of special circumstances to sell an extra number of papers. This is done every day in our streets, and the slightest incident of a sensational character is made to serve the news-vendor's purpose.

Almost any one can take advantage of an opportunity that is thrust under his nose, but it is not given to many boys to conceive how to create the opportunity and at the same time reap all the benefits

arising from it. We are also struck with admiration when we see how the lad pressed the various persons—compositor, telegraph clerk, editor, and engine driver into his service.

Yet this was done by Thomas Alva Edison, who now stands before the world as the greatest inventor that ever lived. In the following pages we shall show how the train boy gradually forced his way through the world, until he reached the topmost rung on the ladder of fame.

CHAPTER II.

A DUTCH SCOTSMAN.

Now that we have introduced the hero of our story, let us for a moment glance at the history of his family.

Nearly three hundred years ago, the Dutch established a settlement on Manhattan Island, at the mouth of the newly-christened Hudson river. They built a fort to protect their traders, and gave it the name of New Amsterdam. About fifty years later this settlement, which had grown into a town, came into the hands of the British, and its name was changed to New York. It is to-day the largest city in America, and one of the largest in the world.

Though the greater part of North America had become British, Dutch emigrants still continued to cross the Atlantic and settle among their countrymen. In 1737 a family, named Edison, was among the number, and John Edison became a famous banker in New York.

In 1765 there were thirteen colonies in North America south of the St. Laurence and the Great Lakes. The colonies were of a mixed nationality—British, French, Dutch, and Swedes—but all were under British rule, and proud of their connection with the greatest country in the world.

In an evil hour the British Parliament decided to tax the American Colonies, and a great quarrel broke out between the colonists and the mother country. The Americans absolutely refused to be taxed without their own consent. They did not send members to the British Parliament, and therefore they declared that there should be "No taxation without representation."

War followed, and many battles took place with varying success. George Washington came to the front, and under his able leadership the Americans at first held their ground, and then were successful in finally defeating the British, at Yorktown, in 1781. In January, 1783, a treaty of peace was signed at Paris, in which the independence of the United States was acknowledged. Since then it has been a separate country, and ruled over by Presidents elected by the people.

John Edison, the Dutch Banker, was in favour of British rule, and did not agree with those who advocated separation. With many others, called United

Empire Emigrants, or loyalists, he left the States and took up his residence in Nova Scotia. By this action he was entitled to receive six hundred acres of land for himself, four hundred for his son Samuel, and two hundred for each of his son's children.

In 1811 he claimed the land, but he was not successful in obtaining it. He and his son lived to a good old age, and were both over one hundred years old when they died. Samuel Edison the second, the grandson of John, lived at Bayfield, on Lake Erie; but while remaining in Canada, he had no great affection for the Government. He could not forget the wrongs of his family. The land to which they were entitled had never been made over to them.

The disaffection of the Canadians at length induced a rebellion, and several strong positions were taken and fortified against the Government troops. The Americans gave the Canadians some assistance, and for a time matters looked serious, but in the end the Government put down the rebellion, and peace was restored. The *Caroline*, a vessel which the Americans had used to carry stores to their friends, was seized by the British, set on fire, and sent over Niagara Falls.

One of those who took a leading part in the rebellion was Samuel Edison, of Bayfield, the grandson of the

loyalist banker. He was evidently a man of mark among his fellows. We are told that "He was six feet tall, and straight as an Indian, supple of muscle and strong of limb, he ranked among the finest athletes of the day, and had no peer in swift and protracted running." He became a captain in the rebel forces, and was one of the most energetic in action.

When the rising proved a failure, the leaders endeavoured to escape the consequences of their action. A general stampede of rebels took place, and there was a race for life over the border. Samuel Edison had before him a journey of nearly two hundred miles, and until he had accomplished that distance he never stopped for food or rest. Not until he had crossed the river St. Clair, did he feel safe from those who were now his most deadly enemies.

Those who were not as successful as Edison were either executed or banished. The property of the rebels was also destroyed by fire. It is a curious fact that the land awarded to the grandfather for his loyalty, became the cause of the grandson's rebellion, which ended in forcing him to flee from the country of his adoption. Samuel bids fair to equal his forefathers in length of life. He is still alive, and at the present time (1895), at the age of ninety, he is vigorous in body and mind.

Samuel, while in Canada, married Nancy Elliot, who belonged to a Scottish family, that had lived some time in the New World. She was therefore a Canadian by birth, and of Scottish parentage. She had received a good education, and was for some years a teacher in a Canadian high school. She is described as a sweet-tempered woman, of rare abilities, and well qualified to educate and train her children.

After staying a short time at Detroit, Samuel removed to Milan, Erie County, Ohio, and there, on the 11th of February, 1847, his son Thomas Alva Edison was born. At this small lake port Thomas spent the first seven years of his life, and at an early age gave evidence of the genius which has made him the most famous inventor the world has ever seen.

Before he was six years old he showed much interest in the faithful manner, in which a goose sat day after day on the eggs she was hatching. And when at length her patience was rewarded, and the family of goslings appeared, he was astonished to learn that the heat of the mother-bird's body had produced this result. How long he pondered over this, his first lesson in organic chemistry, we are not told, but one day he was missing, and an anxious search in every likely place proved vain. At length his father happened to go into the barn, and there he found his enterprising son,

sitting on a batch of eggs, which he had collected. He was actually trying to hatch them.

When Thomas was seven years old, a new railway so affected the trade of Milan, that his father decided to remove to Port Huron, in Michigan. Here the Edisons lived in a large, white farmhouse, which overlooks the river that forms part of the boundary between Canada and the United States. In his new home the intelligent lad received instruction from his mother, who was his only teacher, except for one short period of two months at school.

The boy's thirst for knowledge soon showed itself in the books he not only read but endeavoured to master. Before he was ten he had gone carefully through "Hume's History of England," "D'Aubigné's History of the Reformation," the "Penny Encyclopædia," "Ure's Dictionary of the Sciences," "Sear's History of the World," and "Newton's Principia." He also set himself the task of reading all the books in the Detroit Free Library, and he succeeded in getting through fifteen feet of books, without passing over a single word in any one of the volumes. It is said that, young as he was, he could refer to the very page in any book he had read, which contained a passage or an incident in which he was interested.

These ponderous volumes scarcely seem to be just the

stuff to sharpen a boy's wits, and yet it was at this time that he was acting as train boy, and reaping the benefits of his own ingenious contrivances to create a boom in newspapers.

CHAPTER III.

RUNNING A PAPER.

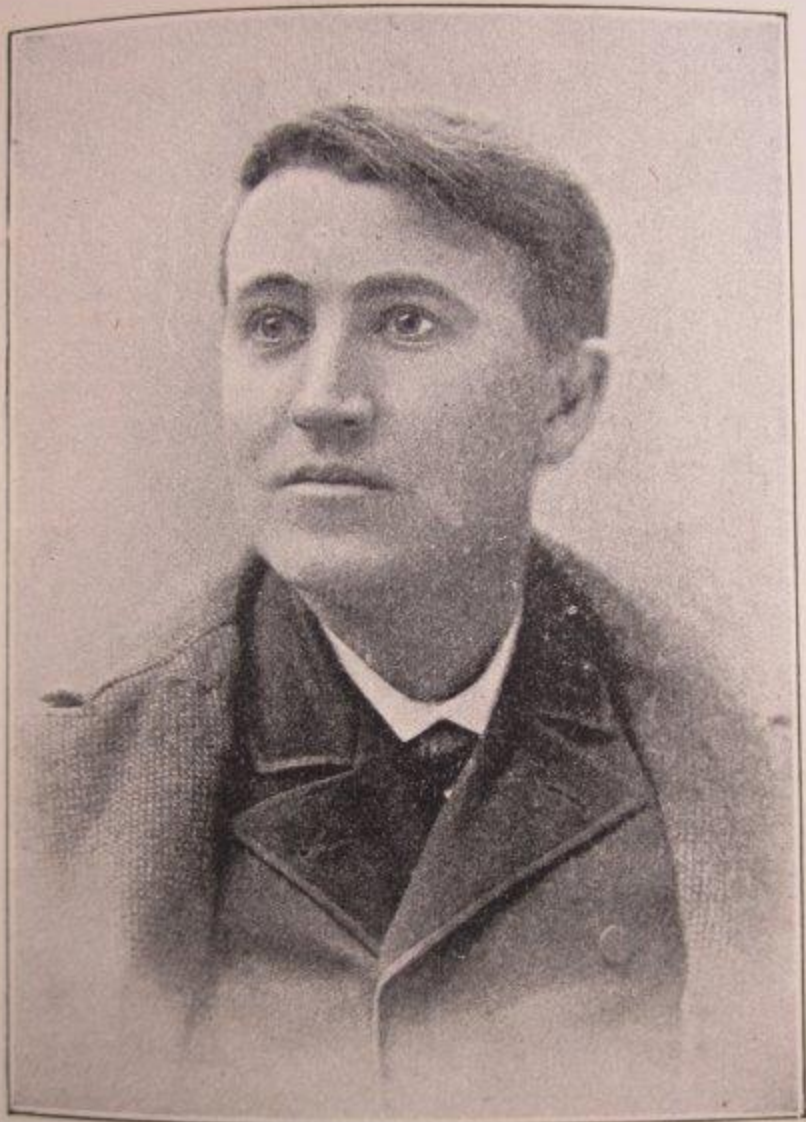
EDISON was not satisfied to act simply as the hands of other persons. He could not be content to do duty merely as a machine, set in motion and controlled by a greater power. He must use his mind as well as his hands, and do something towards creating the power. He was quite willing to sell what others produced, but he also felt that he could help in the production.

From the owner of the *Detroit Free Press* he bought a quantity of type. Then he got permission to use the smoke-room of an old car, which ran on the line where he sold papers. This he fitted up as a printing establishment, of which he was the sole staff. As the train performed its daily journeys, the busy editor, compositor, and printer of the *Grand Trunk Herald*, as he called his journal, wrote, set up, and printed his weekly budget of news.

The sheet, for it was only printed on one side, was

sixteen inches by twelve, and was printed without the assistance of a press. The cost of such a machine was beyond the purse of the ambitious youth. Yet, who ever before heard of printing a newspaper without a press? Only an ingenious mind like Edison's would have dreamt of such a thing. He not only thought of it, but he did it, and by simply pressing the sheets on the types, he produced several hundreds of copies of his paper.

It may interest our readers to see a few extracts from the paper, published by this enterprising youth, under the difficult circumstances, which we have just described. Under the head of "Local Intelligence," we read, "Premiums—We believe that the Grand Trunk Railway, give premiums every six months, to those of their engineers, who use the least wood and oil, running the usual journey. Now we have ridden with Mr. E. L. Northrop, one of their engineers, and we do not believe that you could fall in with another engineer, more careful, or attentive to his engine, being the most steady driver that we have ever ridden behind (and we consider ourselves some judge, having been railway riding for over two years constantly), always kind and obliging, and ever at his post. His engine, we contend, does not cost one-fourth for repairs, which the other engines do. We would respectfully recommend him to the kindest consideration of the G.T.R. Offices."



THOMAS ALVA EDISON.

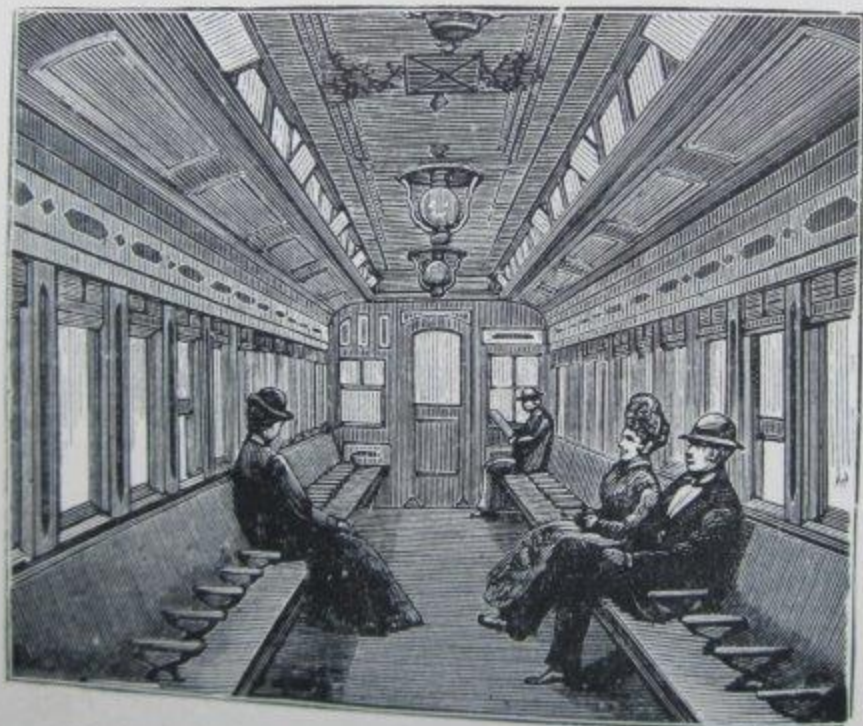
Even in this paragraph, the young editor is fully alive to the advantages, which all newspaper men know may be obtained, by a little judicious puffing. At any rate Edison knew the value of being on the best possible terms with the officials of the train, in which he made his living.

In the same issue we find another paragraph of the same class in which the "one porter" of Utica Station is highly commended for the order and cleanliness of his platform, on which "the snow does not lie for a week after it has fallen, but is swept off before it is almost down."

Then there is an account of how a gentleman "didn't succeed" in swindling the Grand Trunk Railway Company out of a large sum of money, to recoup him for a bag which he pretended he had lost while traveling. When the bag was found in the gentleman's possession, his friends offered money to have the matter hushed up. "Not so," writes Edison; "we say that the villain should have his name posted up in the various stations of the country, and then he would be able to travel in his true colours."

After this there is a commendation, of a very successful recruiting-officer, then a notice of heavy shipments of flour and hogs, a birth, a notice that the paper is to be enlarged, and that every subscriber's name would be printed on his copy.

Under "News," we read that, "The thousandth birthday of the Empire of Russia will be celebrated at Novgorod in August." Of course the paper has its little joke. "Let me collect myself, as the man said when he was blown up by a powder mill." Then follow railway notices, mails, markets, and advertisements.



AMERICAN RAILWAY CAR—INTERIOR.

This paper was sold at three cents ($1\frac{1}{2}$ d.), and it soon had a circulation of four hundred copies. Occasionally it contained contributions from leading railway

men, who could not but admire the boy and his work. Robert Stephenson, the great engineer, was so taken with it, that he ordered an extra edition for his own use. The *Times* (London) gave it a favourable notice, and so made Edison's name known on this side of the Atlantic.

He next entered into partnership with a printer's boy, and together they issued a paper called *Paul Pry*. It was a superior production to the *Grand Trunk Herald*, but indulged in plainer speaking. The result was that an indignant subscriber, who had been referred to in anything but complimentary terms, threw the editor-in-chief into the St. Clair river.

Edison was not much alarmed at this hostility. All editors, and especially those on the other side of the Atlantic, know the price they must occasionally pay for freedom of speech. They count the cost and risk having "to foot the bill."

Edison was so much interested in chemical experiments that he spent all his spare time in scientific studies of one kind and another. He had in his travelling printing shop a quantity of chemicals, and one day the jolting of the car caused a bottle of phosphorus to fall and explode. In a moment the car was on fire, and in rushed the conductor. Before Edison well knew what had happened, the man had

soundly boxed his ears and injured his hearing for life. He was then bundled out of the train with all his belongings, and left stranded by the side of the line.

We do not know what thoughts passed through his mind as he stood there, watching the receding train. The sudden break-up of all his plans and schemes, and working arrangements, must have been a great shock to him. "In all the sorrowful incidents of his life, and they were many, nothing more desolate can be imagined than the figure of the ill-clad, ill-fed boy, standing irresolutely on the deserted road, the fragments of his cherished possessions around him, and in the gradually increasing distance the outlines of his beloved workshop and sanctum."

Nothing could be gained by inaction, and so gathering up his property he made his way to his father's house at Port Huron, and stowed it away in the cellar. Here he conducted his experiments and made the electric telegraph a special object of study. He was very anxious to thoroughly understand, not only how messages were sent from the operator's point of view, but also how the telegraph was constructed, and the principles on which it was worked.

With his friend James Ward he laid a line of telegraph from the workshop in the cellar to Ward's

house, some little distance away. Stove pipe wire was used and insulated by bottles, and a piece of an old cable, fished out of the Detroit river, carried the line under a busy thoroughfare. Old wire wrapped in rags served as magnets, and then the boys proceeded to generate an electric current. Perhaps, as an instance of ingenuity this experiment was never equalled, unless it was when the same lad attempted to hatch chickens and goslings by the heat of his own body.

Edison and Ward captured two cats, to the legs of which they attached wires, and then they proceeded to generate a current of electricity by violently rubbing the animals' backs. Mr. Reid, who gives this incident in his memorial volume, says, "The experiment was not without success. A tremendous local current and perfect electric arc were produced, but it would not work the line, and was abandoned. The experiment illustrated the humour of the man."

The matter-of-fact reader and the ordinary worker, who never by any chance do a foolish thing or give others cause for scornful laughter, may be inclined to regard these unpromising experiments of Edison's as instances of weakness rather than of evidences of strength. But then such men, who have a great horror of being thought foolish, never benefit themselves or others by their discoveries, for they never,

even by accident, make any. Every man who has led the way in science, has at one time or another been laughed at as a dreamer or a madman. Again and again has it been his lot to hear the mocking voices of would-be wiseacres, who knew less, and cannot see half as far.

Speaking of the incident of the cats, Mr. Johnson, for many years Edison's associate, says, "It is perfectly characteristic of the man. He will to-day undertake elaborate experiments and conduct them with great care and marvellous patience and perseverance, although his reason points to their utter futility. It is this trait, however, which led him into lines of original discovery and observation unattained by others.

After this failure, the boys put together their savings and bought some old batteries and telegraphic instruments. They were then able to put their private line in proper working order. Many years after this a gentleman told the following story. He said, "I knew Tom when he was a barefoot boy, and he was always tinkering with telegraphy, and once rigged up a line from his home to mine, a street away. I could not receive very well, and sometimes I would come out, climb on the fence and halloo over to know what he said. This always made him angry. He seemed to take it as a reflection on his telegraph line."

CHAPTER IV.

A CLEVER OPERATOR.

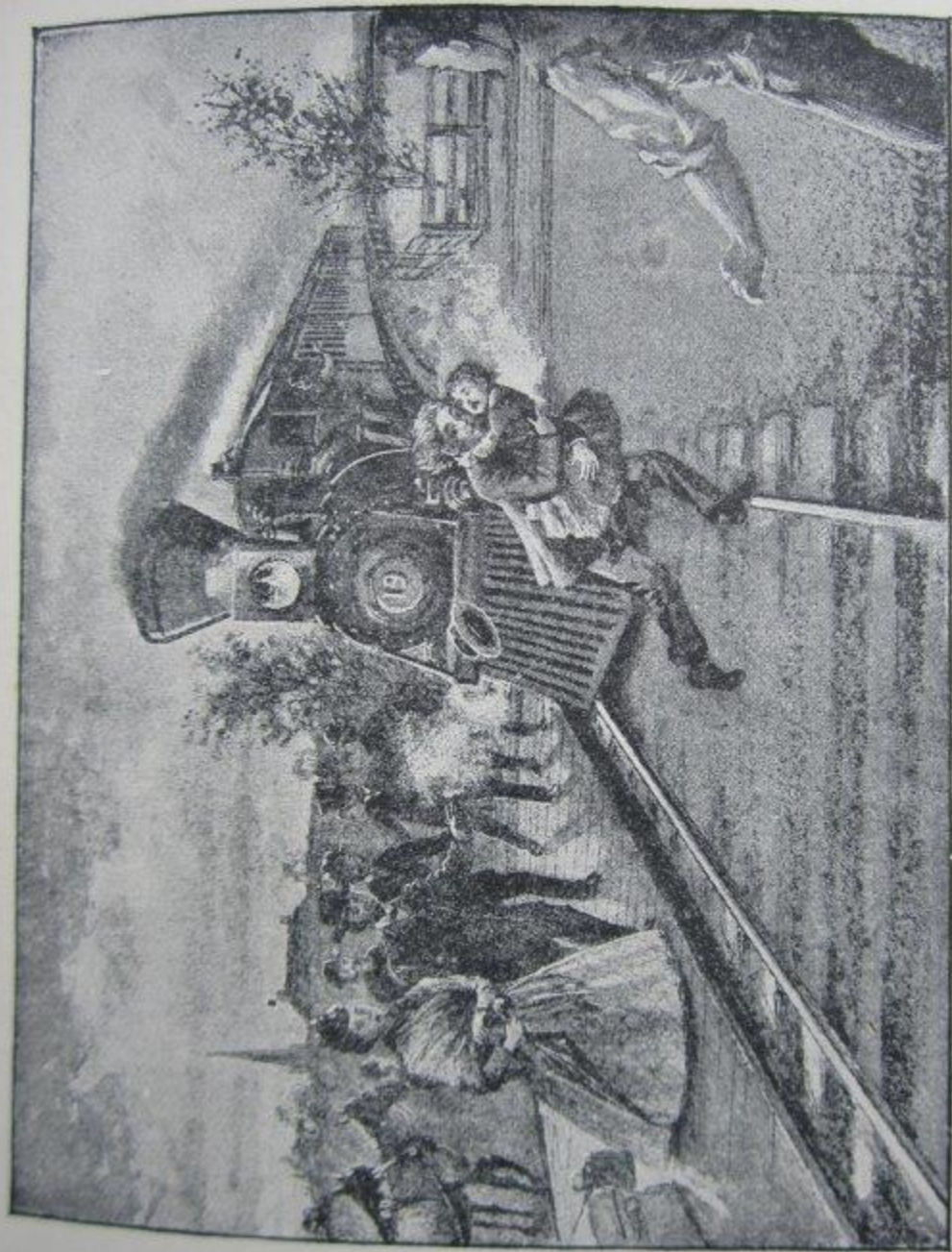
THOUGH no longer the proud owner of a newspaper, edited and produced by himself, Edison continued to supply the travelling population, between Detroit and Port Huron with newspapers. And though this occupation could scarcely be regarded as a permanent one, or as a stepping-stone to a business or a profession, it enabled the lad to keep himself and assist those at home. Out of his small earnings he always gave his mother at least a dollar (4s. 2d.) a day towards household expenses.

He had been so long on the road as newsboy, that he was well known to the officials, and a great favourite with all. No one could help admiring and respecting the hardworking intelligent lad, who could turn his hand to anything, and never seemed to meet a difficulty that he was unwilling to face, and that he did not eventually surmount.

The train, which Edison travelled by, spent half-an-hour every day shunting at Mount Clemens Station. And the newsboy became very friendly with Mackenzie, the station-master. This man had a child, a little boy about two and a half years old, named Jimmy. Edison was very fond of the baby boy, and often had a romp with the child, when he had finished his business, and was waiting for the train to start.

One morning, while the shunting was going on, the child strayed on to the line, and was standing throwing pebbles over his head. Just then a wagon was cast off the back part of the train and pushed towards the place where Jimmy was standing. Edison saw the child's danger, threw down his bundle of papers, and saved the little one's life at the risk of his own. It was only by the narrowest shave that he flung himself and the boy out of the way of the moving car. As it was they both fell on their faces, and were badly scratched by the rough pebbles and cinders between the lines. A moment later, and Edison would have lost a foot or been killed, as the wheel of the car struck the heel of his boot.

Hearing the cries of those who had witnessed the danger of his child, Mackenzie rushed out of the ticket office and saw the men carrying Edison and Jimmy on to the platform. He was not a rich man,



EDISON SAVING THE STATION-MASTER'S CHILD.

and could not show his gratitude to his child's preserver by making him a handsome gift, so he offered to teach him all he knew about telegraphy. Edison was delighted with the offer, and gladly accepted it. A day or two afterwards the lad began to take lessons, and in ten days he managed to construct a complete set of instruments no larger than an ordinary envelope.

Always practical in all he did, and anxious to take advantage of every opportunity of making money, he constructed a short telegraph line from the town to the station, and set up his instruments in a druggist's shop. His charge for a message was twelve and a half cents ($6\frac{1}{2}$ d.), and during the first month he had the pleasure of sending three messages. In the meantime he made such rapid progress that he was soon able to teach his teacher, and he made several improvements on the cable, which carried the messages between Port Huron and Sarnia.

At length he was appointed to take charge of a telegraph station, when he was sixteen years of age, with a salary of twenty-five dollars (£5) a month. About three months after he had received the appointment, some special work was required, and Edison was promised a sum of money if he succeeded in doing it. Then, to his disgust, the reward was not forthcoming.

so he threw up the place and went to Stratford, in Canada, where he acted as night operator.

At Stratford, Edison appeared for the first time in the rôle of an inventor. It was very important that the night operators should not fall asleep at their posts. So a rule was made that every one of them must telegraph the number "6," every half-hour, to the manager of the section on which he was engaged. This was regarded as evidence that the operator was awake and at his post.

Edison did not like the rule. Sometimes he was very sleepy and sometimes he wanted to take a walk. Of course he had no right to do either. His duty was to stick to his post, keep awake, and duly report himself as required. But his ingenuity suggested another way out of the difficulty, which got him into trouble. He constructed a wheel, having notches cut at the outer edge. This he attached to the clock and connected it by wires with the main line circuit. The result was, that the number "6" was given regularly no matter where he was, or what he was doing.

Soon, however, the manager noticed that Edison could never be got to reply to a message just after the "6" had been received. He, therefore, concluded that something was wrong, or some explanation required. A man was sent to find out the real state of affairs.

and Edison's labour "saving device" was discovered. Though intended by the inventor to enable him to evade a duty, it was of use for other purposes, and was afterwards patented and sold to the American District Telegraph Company.

Not long afterwards Edison was guilty of another breach of duty, which brought about his dismissal. One night he received a message to stop a certain train, and not attending to it at once, the train passed through without stopping. Knowing that there was danger of a collision taking place, he rushed out to a luggage station near, at which most of the trains stopped, hoping to find it there, and so prevent any harm from being done. In the darkness he stumbled and fell, and by the time he had pulled himself together the train was completely out of his reach. Back he hurried to the telegraph office, and tried to prevent a collision by sending a message after the train, but it was too late to be of any service. Fortunately the two trains came in sight of each other on a long straight part of the line, and the vigilance of the engineers saved them from the threatened disaster.

Edison was at once suspended, and required to wait on the general manager, who spoke to him very severely.

"Young man," he said, "this offence of yours is a

very serious one, and I think I shall make an example of you. I can send you to prison for five years, and——”

The sentence was never finished. At that moment visitors from England were shown into the manager's room, and he rose to meet them. While they were engaged in conversation Edison slipped quietly out of the room and made for the luggage station as fast as he could. There he found a train about to start for Sarnia. The conductor was willing to allow him to travel by it, and in a short time he was over the boundary and safe at Port Huron. He says, “I haven't been in Toronto since that time, nor have I yet received the pay due to me up to that date.”

While staying at Port Huron, the blocks of ice in the river cut the telegraph cable between Port Huron and Sarnia. Edison thought he could manage to communicate across the stream, which was a mile and a half wide, without a cable. Jumping on to an engine he caused the whistle to make sounds, like the dots and dashes of the telegraphic symbols. In a short time the sounds were heard and noted, and there came back a reply. So that messages could be whistled across until the cable was repaired. When this incident became known, it added no little to Edison's fame as an operator.

He was now seventeen years of age, and his knowledge of telegraphy was greater than that of the majority of those who had spent many years at the work. He was not long without an appointment; in fact, during a comparatively short period he held several. It was much easier for him to get a post than to keep one. His love of joking, and his fondness for experiments, caused him to get into trouble again and again. The managers were willing enough to recognise the abilities of the clever youth, who seemed to treat the telegraph instruments as playthings, but they could not afford to have the rules which had been framed for the good of the service, set aside by anyone in their employment.

At one place he was praised and blamed, complimented and dismissed at the same time. He had invented an instrument, by which a message could be transferred from one line to another, without the assistance of an operator. For this he received praise. Because he was so much engaged in trying experiments he was discharged. What was wanted was not an inventive genius, but a steady-going, trustworthy, human machine, which either could not or would not think, and who would never dream of attempting to teach those, who were supposed to know more about the work than he did.

CHAPTER V.

A GREAT SUCCESS.

EDISON was anxious to be engaged in the highest paid telegraphic work, that of receiving "press reports," and he obtained permission to try his powers. The system he invented, of adjusting two receiving registers, the one for the reception of the news, and the other for the repeating of the embossed writing, was very successful for a time. But unusual pressure of work made it impossible to keep pace with the dispatches, and so many complaints of delay were received from the newspaper offices, that Edison was sent from Indianapolis to Cincinnati. There he worked as a day operator, for sixty dollars (£12) a month. He also earned something by assisting the men on night duty.

One night, all the operators joined in a revel with some visitors from another town, and when all were out of the office but Edison and the office boy, the telegraph began to work. Alone, the skilful operator worked all

night, and succeeded in supplying the gap. He was also on duty at the usual hour next morning, ready to do his day's work. He did not intend to say anything about the events of the night, but the office boy told the manager, and Edison's salary was nearly doubled as the result.

He was then placed in charge of the Louisville wire, over which were sent all the southern reports. Fortunately for him, the operator at the other end was famous for his speed and clearness, and the practice Edison had with this gentleman, placed him at once far ahead of the other operators.

His next move was to Memphis, in Tennessee, with a still larger salary and board. Here he had the misfortune to have a manager, who had been trying for some time to perfect a repeater of his own invention. Edison soon made the thing work, and was then dismissed for his pains. Jealousy, as in this case, often causes acts of injustice.

Edison could scarcely have been thrown out of work under more unfavourable circumstances. He was absolutely penniless. All his money had been sent home, or spent on books and instruments, and his clothes were very scanty, and would scarcely hold together. To make matters worse, he was not in very good health, for the long hours and want of sleep had begun to tell

on his constitution. He was cast down, but not beaten. Feeble, penniless, and sore-hearted, he walked one hundred miles, and then obtained a free ride to Louisville.

William Foley, also a telegraph operator out of work, joined him at Nashville, and the two lads pursued their journey together. At length they entered Louisville, and tried to obtain employment. The manager was not prepossessed in Edison's favour. How could he be? Clothes may not be a true indication of respectability, or the contrary. But soleless shoes and thin linen garments in winter, worn by a weary, hungry-looking lad, could not but awaken suspicion.

The manager, however, heard what he had to say, and his bright, earnest manner, and the evidences of his skill, told so much in his favour, that he was at once engaged. Here he remained two years, though he suffered much from the coarse and unprincipled conduct of those with whom he was obliged to associate. In time they came to know him and appreciate his kind disposition, his innocent and studious life, and his willingness to do any one a good turn. They felt he was not, and never could be one of them, yet they could not withhold from him the respect he inspired wherever he went.

On one occasion he took the press report of Andrew

Johnson's Presidential message, at one sitting of thirteen hours, from half-past three in the afternoon until half-past four on the following morning. He then paragraphed the matter so that a few lines could be given to each compositor, and the report that had taken him all night to receive, was set up in a few minutes. This incident was honoured by a state dinner given to him by the Louisville Press.

One night, when Edison was on duty, one of the most skilled operators in the service, but a victim to intemperance, entered the office under the influence of alcohol. Walking up to the stove he kicked it over, and then pulled down all the apparatus, and left the room a complete wreck. Edison quietly rigged up one of the wires, and did all the work just as if nothing had happened.

Being a sober, trustworthy man, the rest made Edison their treasurer, so that none of them should be able to get more liquor that was good for him and for the work during office hours. A new man came to the office, who fell in with the plan; but when the treasurer refused to give him more money than he was entitled to, the man at once knocked him down, and would have done him serious mischief if the others had not interfered. This they did so effectually, that the man spent three weeks in the hospital.

As he was the only one who ever had any spare money, for he spent nothing in dissipation of any kind, the demands on his purse were frequent, and his patience was tried to the utmost. His books were carried off and pawned, and he sometimes found his bed occupied by drunken operators, who lay there dressed and with their boots on.

After a time a new office was built at Louisville, and richly furnished. Strict orders were given that the instruments must not be moved from their places, and the chemicals handled with the greatest care. Edison wanted some sulphuric acid for an experiment, and unfortunately upset the vessel which held it. The acid corroded the floor, passed through into the manager's room, injured his desk, and destroyed his carpet. On the following morning Edison was informed by the board of directors, that as they wanted operators and not experimenters, he was at liberty to draw the salary due to him and leave.

Cincinnati next employed the irrepressible inventor, who could not be satisfied with the possession of more knowledge than nine-tenths of the telegraph operators in the country cared to acquire. Here the engine shed was so near the operating room, that Edison took a more than usual interest in the locomotives stabled there. He even borrowed one and made a trip on his own

account when the driver and the fireman were away. He returned in safety, for when he was a train boy he learned how to handle an engine, but it was not just as smart in appearance as he found it. By overfilling the boiler he brought down a shower of dirty water and soot, ejected from the funnel on the engine.

We next find him back again at Port Huron, where he worked for more than a year, until he was twenty-one. Here he invented an ingenious device, which effected a considerable saving, and in return the Grand Trunk Railway Company presented him with a free pass to Boston. When he arrived at that centre of learning, he had been four days and nights on the road, and as usual his wardrobe was neither new nor fashionable.

His appearance at once aroused the mirth of the operators, who determined to "put a job on the jay from the woolly West." They at once pointed out the instrument he was to use, and told him that he was expected to take down a special report for the *Boston Herald*. To make sure of "flooring" the new man, they had wired through to New York, and arranged for one of the fastest senders in that office to send the report.

Edison had long before this made himself perfect in a simple and rapid style of writing, which he could do at more than fifty words a minute, and faster than any one in the United States could telegraph. He therefore

began to take down the report quite easily, as the New York man, to throw him off his guard, proceeded leisurely at first. Before long the pace increased, but apparently without any effort, Edison was quite equal to the task. He then saw, from the faces of the men, who were all looking over his shoulder, that they had arranged the whole thing to get some fun out of him.

Pretending not to notice anything unusual, he remained quite calm, and kept up with the message, even stopping once or twice to sharpen his pencil. Then the New York man commenced to run the words together and stick the signals, but that made no difference to Edison. He had been tried with all kinds of work—good, bad, and indifferent. He put it down in a neat copperplate hand, even crossing his t's and dotting his i's, and putting in all the stops. When he thought that the fun had gone far enough, and the report was about completed, he quietly wired to the operator at the other end, "Say, young man, change off, and send with your other foot." That message was too much for the New York man, who threw up the job in disgust, and gave it to someone else to finish.

The Boston operators tried no more tricks of this kind on "the jay from the woolly West." They were quite satisfied to place him in the front rank of operators, and to allow that a man who could perform the

feat they had just witnessed, could afford to dress as he pleased.

The Boston office was much troubled with cockroaches of large size, which were seen everywhere, and which no human ingenuity had been able to overcome. "No hiding places, however cunningly constructed, could hold their foraging parties at bay; no shelf, hook, or nail afforded any protection against their scaling forces. Over books, papers, instruments, provisions, and garments, lay the shining track of the foe, like the trail of the serpent on the emerald bowers of Eden." But Edison fixed them. Shining tinfoil was fastened on the walls and baited with food. Then it was connected with the battery by means of wires, and as soon as the cockroaches entered the trap they were instantly destroyed.

CHAPTER VI.

ON THE ROAD TO FORTUNE.

A FRIEND named Milton Adams had obtained Edison his Boston appointment. Now, strange to say, Adams was out of employment for some time, and depended on Edison for board and lodging, which was gladly tendered by the one, and as gratefully received by the other.

The two friends had an amusing experience. They were one day walking along the streets when they saw a crowd gathered round two drapers' shops, the owners of which were always trying to undersell each other. They had both got in a large quantity of stockings, the price of which had been lowered, first in one shop and then in the other. It now stood at one cent ($\frac{1}{2}$ d.) for five pairs of stockings.

Milton borrowed a cent from Edison, and, walking into one of the shops, asked for the five pairs of hose, as advertised in the window. A young lady at once handed the buyer five pairs of baby's stockings.

"Oh," said he, "I can't use these."

"Can't help that, young man," was the reply, "we don't permit selections at that price."

Edison continued to spend every spare moment in experiments, and his rooms became "a workshop, laboratory, and library in one." He studied electricity from every standpoint, and often sat up all night reading books on his favourite subject. He was so much impressed with the magnitude of the task, that he said :

"Adams, I've got so much to do, and life is so short, that I am going to hustle."

Having seen in a scientific paper how to make the terrible explosive known as nitro-glycerine, he joined with another operator in making some. Then they tested a very small portion, and were alarmed at the result. So frightened were they to have such a destructive substance in their possession, that they put it into a bottle, wrapped it carefully up in paper, and then, in the early morning, secretly and gently lowered it into a street sewer.

In 1869 Edison invented a vote recorder. It was the first patent granted to him, but he received no benefit from it. He intended the apparatus to be used by the law-makers of the different States, and also in the American Parliament or Congress. If used, it would have enabled each member to record his vote,

without leaving his seat, by simply turning a switch either to the right or the left.

The apparatus was a success, from a working point of view; but as it would have prevented all interference with the members, and made them independent of their party, it was not adopted. In fact, those who controlled the affairs of the House would not have used it if they had been paid to do so.

In a short time Edison was regarded in Boston as an authority on telegraphy, and was engaged to lecture upon it in one of the schools. He made the engagement without asking any particulars, and then forgot all about it. When the time came to go to the school, Adams found him at work on the top of a building fixing a telegraph pole.

Thinking that he was about to address a company of boys, Edison started at once with Adams, just as he was, in his working attire. But when the friends were ushered into the lecture room, they were both struck dumb with astonishment, to see it filled with "an assembly of elegantly-attired young ladies."

For a few moments Edison stood speechless. Then, with a great effort, he managed to overcome his diffidence, and plunge into his subject. Once set going, he kept on, and satisfied his hearers with the brief, pleasant, and clear address which he delivered. His

modesty, combined with a thorough knowledge of his subject, made him a favourite with all the students in the school.

But now, we may ask, what was the result of all Edison's experiments? To what did they tend? What object had he in view? They could not be simply the outcome of a curious mind, or continue year after year as boys say, "just for the fun of the thing."

That Edison delighted in experiments for their own sake, and for the pleasure they gave him when actually engaged on them, is beyond question. But mad, as he seemed to be in the eyes of his less-gifted fellow-workers, there was a method in his madness. He had a purpose in all his experiments, and a definite object in his mind all the time. He knew what he wanted, and he had an idea how to obtain his ends; but the practical part was the difficulty. Theories, like castles in the air, are excellent subjects for day dreams, and may be talked about for any length of time, but the practical application is the difficulty.

The electric telegraph was invented some years before Edison was born, but it was only in its infancy when he first made its acquaintance. Another American, named Professor Morse, constructed the first telegraph line between Washington and Baltimore, in 1843, and in 1844 the first message was sent over the wire.

It consisted of this sentence—"What hath God wrought?"

When Edison came to thoroughly understand the science and the working of telegraphy, he found that there was room for considerable improvement. The application of electricity to the sending of messages, hundreds and thousands of miles, by means of a wire stretched on poles, was as great a marvel to him as it was to the ignorant rustic, who regarded it as a species of magic. But his keen eye, directed by an inquiring mind, saw beneath the surface, and he was persuaded that the system in use was imperfect and too limited in its application. He felt that he could get more and better work out of it. Hence his experiments.

He began at the beginning. He learned all that the operators knew about the apparatus. As a rule this information satisfied them. It enabled them to perform work, which was valued at so much a month or year. It was not their business to know more. They did the work and earned the money. Then, their part ended. But Edison would not have rested there if he had been paid ten times the amount the best operator ever received. He wanted, and must have, a perfect machine.

At the end of six years, that is in 1869, he was satisfied that he had hit upon an improved system. So

he left Boston, and went to New York. He was eager to have his invention put to a practical test. He believed that he had found out how to send two or four messages at the same time over a single wire. He knew that such an improvement was of the greatest value to any busy community. And so it proved to be. When it came to be adopted it was a gain of millions of pounds to the telegraph companies on both sides of the Atlantic. By its means one wire did the work that had required the use of two or four.

Edison's system of telegraphy is now regarded as one of his greatest triumphs. But when he went to New York, in 1869, he had still to persuade those who had money to spend in carrying out his ideas. This they were far from eager to do. Clever as he was, he wandered about the streets for three weeks before he could even get employment.

At the end of that time he was tired and disheartened, and it was with difficulty he could obtain even sufficient food to support life. Calling at the office of The Laws' Gold Reporting Company, he asked for work. At that moment the head of the firm and his manager were at their wits' end to discover what had gone wrong with their gold indicator.

This was an instrument which Mr. Laws had invented, and by means of which the price of gold was

reported in hundreds of brokers' offices in the city. When it refused to work, all business was suspended, and messengers were sent hurriedly from every office to inquire the cause. Just when the master and his manager were in despair, and the office was besieged by hundreds of boys, Edison walked in, hurriedly examined the instrument, and then said,

"I think, Mr. Laws, I can show you where the trouble lies. There is a contact spring which has broken and fallen between two cog wheels, and prevents the gear from moving."

Mr. Laws was only too glad to be shown a way out of the difficulty to resent the stranger's interference. Edison quickly removed the obstruction, and the instrument was shortly at work again. The breakdown of Laws' indicator, and Edison's timely appearance and ability to repair it, proved a piece of great good fortune to the destitute operator. On the following day he was engaged to take charge of the whole machinery of the vast establishment, at a salary of three hundred dollars (£60) a month.

Never was there a better illustration of Shakespeare's lines :

"There is a tide in the affairs of men
Which, taken at the flood, leads on to fortune."

Edison's reward had come at last, and he had now

opportunities and means to carry out the schemes which had cost him so much labour to work into a practical shape. He had not been long in Mr. Laws' employment before he invented a better instrument, to take the place of the one he had put into working order.

After this he invented a number of private printing telegraphic appliances, of which the Gold and Stock Telegraph Company wished to buy the patent right. Edison made up his mind to ask what seemed to him a large sum, viz., five thousand dollars (£1,000). But as he needed money for further experiments, he was prepared to take any smaller sum rather than not sell it.

To his astonishment the Company offered him forty thousand dollars (£8,000), which he at once accepted, and he received a cheque for that amount. Afraid that there must be some mistake, and that he would not get the money after all, he hurried away to the bank at which the cheque was payable. This was his first visit to a bank, and after watching how others went about the business, he walked up and presented his cheque.

The bank clerk said something which, on account of his deafness, Edison could not understand. So the disappointed inventor turned away without the money. After sitting on the bank steps in despair for a time,

he went back to the office where he had received the cheque, and told one of the clerks of his difficulty. This man explained to Edison that the clerk at the bank would not pay the money, until some one they knew said that he was the man to whom the cheque was made payable. The clerk went back with him, and the money was at once paid.

CHAPTER VII.

WORK AND MARRIAGE.

THE money which Edison received for his inventions was nearly all spent in fitting up a shop in which much valuable work was done. One invention after another was turned out, the majority of which were connected with telegraphy. The result was, that all looked to him to solve any difficulties, which defied the efforts of other people. The failure of other inventors was his opportunity, and he certainly did not fail when he was called in to remedy a defect or complete an imperfect instrument.

In 1873 he entered into an agreement with several important firms, to give them the first offer of all his telegraphic inventions. In return they paid him a large salary, and placed as much money at his disposal as he required. Soon he had a large establishment in full working order, and was employing three hundred men. In his factory there were no fixed hours of

labour, and yet there was no waste of time or material and no confusion in the works.

The spirit of Edison was infused in the men he employed. His eager, earnest, persevering, and withal bright and cheery manner, acted like magic on all who served him. Somehow, every man felt the influence of his master mind, and was so considerately treated, that he seemed to become a part of the wonderful inventive genius, whose conceptions were as inexhaustible as his patience. There was but one interest in that concern, but one object, and that was to carry out the plans of the master. It was no uncommon thing for the men to become so interested in their work, that they begged to be allowed to return in the evening to complete the experiments on which they were engaged.

Nor was Edison afraid to let his men see the joy he felt when an invention turned out successfully. It was no unusual thing for him to go through the works and distribute sums of money among those who had an important experiment in hand. He also joked them on their inability to do certain work that was much wanted in a given time, and so incited them to put forth all their skill and work with the utmost speed.

When so engaged Edison forgot everything else. He even forgot to pay his taxes, but the tax-collector did not forget him. Government officials charged with

this duty never suffer from a bad memory. So one day the inventor received a notice informing him, that unless the tax was paid on the following day, he would be charged an extra sum as a fine for his delay. Next morning, when he went to the city hall to pay the tax, he found a great many before him who had received a similar notice. Taking his place at the end of the line, he waited his turn. Until it came he was busy thinking about an experiment he had in hand, and was suddenly aroused from his absent condition by the words, sharply uttered,

"Now, then, young man, look sharp. What is your name?"

Edison looked blankly at the face of the official, and then as blankly said—"I don't know."

At once he was waved aside, another took his place, his chance was lost, and he had the extra money to pay.

He was especially successful in working out a system of automatic telegraphy, by means of which the work was done without the assistance of an operator. It consisted of three machines, one for recording the words on paper, one for sending the messages, and a third for receiving them. The speed at which this could be done was simply marvellous. Over some wires the rate varied from eight hundred to a thousand

words a minute. The wire between Washington and New York could carry as much matter as equalled all the ordinary correspondence between the two cities.

The number and variety of Edison's inventions make it impossible even to mention them, while a description is impossible in a small work of this kind. The details of those completed before he was twenty-four years of age would fill enough books to make a respectable library. The official in charge of the office described the inventor as "a young man who has kept the path to the patent office hot with his footsteps."

Like many other great men Edison could continue for a long period without sleep, and when the work was done, he could fall asleep at once, and enjoy an equally long period of rest, until he had made up the loss. One thing told very largely in his favour, he never touched intoxicating drinks or any kind of stimulants, and therefore nature was not interfered with.

On one occasion Edison received an order for six thousand pounds worth of machines. They were to be constructed from a model which had worked successfully, but when the first was finished there was found to be something wrong with it. Edison could not at first discover the cause of failure, but that only made him the more determined to remedy the defect. Taking a number of his best workmen to the top room in the

factory, he locked the door, put the key in his pocket, and said,

"Now, you fellows, you'll have to stay here until this job is completed."

As there was no appeal from the decision of the determined inventor, and as the men were devoted to him, the work went on, and continued for sixty hours, without sleep and little food. Then the mischief was discovered, and the men were allowed to take the rest they sorely needed. Edison refreshed himself after the strain by a sleep of thirty-six hours.

Edison also had an idea of his own about food. He expressed a wish not to have the same thing to eat twice in a month. He believed that variety in food "is the secret of wise eating." He says that "the nations that eat the most kinds of food are the greatest nations." To illustrate his theory he referred to the various peoples of the earth and their staple food. "Rice-eating nations never progress," he said; "they never do or act anything but rice, rice, rice for ever."

One day, in 1873, Edison stopped to watch one of his young lady assistants who was attending a machine for writing by electricity. He remained so long that it was a question whether it was the machine or the good-looking operator which was engaging his attention. His persistent stare made the girl so

nervous that she could not work, and was obliged to stop.

Then, with a smile, Edison asked her if she was afraid of him, and by one or two questions managed to draw out of her the fact that she liked him.

"Oh never mind explaining," he said, "you can do that some other time. In the meantime will you marry me?"

Probably the young lady had become so accustomed to the rapidity with which electricity did its work, that she was not shocked at the "electric speaking" of the master of electricity. She consulted with her friends, and shortly afterwards Mary E. Stillwell became Mrs. Edison.

It is said that a friend was passing Edison's laboratory very late on the inventor's wedding day, when he looked up and saw a light burning. Entering the building he found his friend, as usual, completely engrossed in an experiment.

"Tom," he said, "it's past midnight. Aren't you going home?"

"What, is it so late?" replied Edison. "Past midnight! And now I think of it I was married to-day. Yes, I had better go home at once."

If Edison had not found a wife to his liking inside his works it is highly probable that he would have

remained a bachelor. He never seems to have gone into society in those days, or to have associated with many persons outside the scientific world in which he moved. Certainly, having found the right woman, it was a good thing that she had an intimate acquaintance with the ruling passion of his life.

One thing she could not say after her marriage, which a lady from the outer world might have said, that she did not expect to find him so thoroughly devoted to his scientific experiments. As a fellow-worker she knew exactly what manner of man she was uniting herself to, and what to expect from him after their wedding.

That she was a sensible woman and possessed of tact, is beyond question. She entered more heartily than ever into her husband's schemes, and became a part of her husband's life, as few wives have an opportunity of doing. She also retained the respect and affection of those with whom she had previously worked.

Before his marriage Edison had neither regular hours for eating nor for sleeping. He left these things to take care of themselves. He took food when he could go no longer without, and he slept when he could no longer keep awake. He tried Nature to the utmost, but as he was wise enough not to add to

her difficulties, by forming any dissipated habits or indulging in alcohol, she was a kind mistress and did not inflict too heavy penalties on the "scientific sinner."

After his marriage, Edison endeavoured to remember that he had a wife, and that the well-being of his family had some claims upon his time. He therefore became more regular in his habits, and was not so often guilty of turning night into day. Still, he did not, and could not wholly change his methods. He ever remained the same enthusiastic inventor, and from time to time was so absorbed in his work, that he forgot everybody and everything, but the experiment which he had on hand.

We may here note that when Edison became the happy father of two children, a boy and a girl, he gave them, for their pet names, the two symbols used in telegraphy, a dot and a dash. "Dot" is known to her friends as Mary Estelle, and "Dash" bears his father's name.

Edison settled down at Menlo Park, a quiet spot about twenty-four miles distant from New York. For a time his works remained at Newark, but when he became famous he received too many visitors to please him. He did not object to give a reasonable amount of his time to scientific men like himself, but he would

not be pestered by curious people, who only sought admittance, to be able to say that they had seen the famous inventor at work.

To escape from the constant interruptions of thoughtless people, he at length decided to move his whole establishment from Newark to Menlo Park. There he erected the required buildings, and fitted them up in a magnificent manner. The large workshop, one hundred feet in length and thirty-five feet wide, contained every kind of machine he could possibly need for his work. Here, too, were models of all kinds of apparatus and parts of every kind of telegraphic instruments.

There was also a large library of the best and most recent books for the use of the inventor and his staff. On the shelves were rows of bottles containing the chemicals used in performing the various experiments. There were also specimens of plants, and minerals, and preserved reptiles. From one corner an organ and also a musical box, sent forth sweet sounds from time to time.

Edison had a body of capable assistants and skilled workmen to carry out his plans. His chief assistant, Charles Batchelor, first entered his employment in 1870, and has an interest in his inventions. His private secretary, L. S. Griffin, was at one time his

telegraphic manager. He has also a master machinist, and a professor and assistants to conduct chemical experiments. So capable are his staff that he can get a working model of a new invention constructed in a single day.

CHAPTER VIII.

A MODERN FAIRY.

IN describing the various inventions of Edison we have again and again referred to electricity. In many towns, the word in one form or another, is in constant use. There are electric bells, the electric telegraph, the electric light, and the electric railway. There is also a little machine called the galvanic battery, which is very common.

But do you know what electricity is? If you have a scientific friend, ask him or her—for ladies are now as learned as gentlemen. And if your friend is modest enough to confess that you have asked a very difficult question, which has puzzled some of the cleverest men both of ancient and modern times, you will be the gainer, for he will do what we propose to do in this chapter. That is, he will tell where electricity is to be found and how to use it, but he will not trouble you with a string of scientific terms which tell you nothing.

As we wish to be thought modest we will say at once that we do not know what electricity is. But for fear that you may think that we have not done our duty by our readers, in writing about something that we do not understand, we should like to amend our confession, and say, "We do not know what electricity is, neither does anyone else."

Few men know as much about electricity as its master, Mr. Edison, but even he would be at a loss if pressed for a simple definition, "to be understood by the common people," as an old writer would have quaintly said.

And now, as we cannot tell you what this marvellous thing is, we will tell you what learned men have found out about it. But first of all you must bear in mind that we do not make it, even as we make that powerful agent steam. Speaking correctly, steam is not made; it is produced by changing or turning water into vapour, by means of heat. And the vapour or steam becomes water again. Electricity exists in Nature, and is independent of anything that we can do. It is everywhere at all times, and may be simply described as a physical force, which can produce light, heat, and motion.

It is said to have been discovered by Thales, an old Greek philosopher, who lived some two thousand years

ago. He happened to rub a piece of amber on the rough sleeve of his gown, and then he found that with it he could pick up such light things as bits of down, feathers, and straws, just as we pick up needles with a magnet. This was the first hint, as far as we know, that the world received of the existence of electricity. From the Greek word *electron*, which means amber, this power or force was afterwards called electricity. So you see the name does not help us to get a definition.

The old philosopher tried to explain the cause of the influence exercised by the rubbed amber, on light substances, by saying that it contained a soul or an essence which was aroused by friction, and which came forth from the body, where it had previously laid dormant or asleep. The old Greek's explanation is one that appeals to our fancy, for it requires no stretch of imagination to regard electricity, as being to the metals which it seems to imbue with life, what the soul is to the body. The stirring effect of electricity is present in our minds, when we speak of any one as being electrified by something that has been said or done. We mean that they have been greatly moved to action, as if by an extraordinary force. We never speak of steam, with all its wondrous power, in this light. Steam is a thing that we can in a sense make, and see, and

confine, and handle; but electricity is enveloped in mystery.

We have said that this force is everywhere at all times, and yet to those who do not know how to summon it to their aid, it might as well have no existence. Nay, it reminds us of the fairies described in old stories, who came at the bidding of those who had the secret power of enforcing their attendance. The utterance of certain words, the possession of a charm, a magic ring, a lamp, or a jewel, gave fortunate mortals the service of beings far more powerful than themselves.

So it is with electricity. This force is to men like Edison, what the "slave of the lamp" was to Aladdin in the "Arabian Nights." They are able at will to call to their side this modern fairy, and compel it to work wonders more marvellous than any described in the most startling fairy tale, ever conceived by an Eastern story teller.

There are several ways of producing electricity. Electric machines usually do this by friction. If we rub amber, sealing wax, glass, or sulphur, with flannel, the friction we employ produces electricity. Even the simple act of stroking a cat's back arouses electricity in the cat's fur and in our own hands. The boy Edison knew this, you will remember, when he tried to obtain

electricity from two cats for the telegraph he had made.

A curious illustration of producing electricity by friction has been sometimes performed by rubbing the feet on the carpet and then lighting the gas with the electric spark from the end of the finger.

In a battery, electricity is produced by chemical action in the following manner:—Two metals, a plate of zinc and a plate of copper, are placed in a vessel containing a solution of acid. The plates are not allowed to touch each other in the acid, but the chemical action, which takes place by the acid acting on the metal, produces or generates electricity.

Wires are attached to the plates above the level of the liquid, and along each of them flows an electric current, one of which is called positive and the other negative. When the ends of the wires are brought together, the two currents—positive and negative—meet and produce an electric shock.

This is exactly what happens when a person takes hold of the handles of a galvanic battery. Taking hold of one handle produces no effect, but the moment the other handle is touched by any part of the body, the two currents unite. This is because the human body conducts electricity just in the same way as metal.

Doctors often use batteries to act on the weak muscles of their patients, and a shock may be given to any limb or to any part of the body. We sometimes hear of persons being killed by accidentally coming in contact with wires used for electric lighting or for driving machinery. The wires themselves are harmless, except when it happens that touching them draws the electric current from them to the body. Criminals have recently been executed in America by means of electricity.

On one occasion Charles Batchelor, Edison's friend and assistant, very nearly became his own executioner. He was repairing some apparatus, and thought that he had made an accident impossible, when he happened to touch a wire with each hand, and so establish a circuit. A terrible shock was the result, which for some time deprived him of all power of motion. Staggering to a stool he sat there motionless, bathed in an icy and deathlike sweat, and nervously unstrung from head to foot." The effect of the shock passed off in a few days, but the memory will remain as long as he lives.

In another instance of a somewhat similar kind a man touched wires which brought on him the electric current. He felt the shock for a moment, and then noticed that his waistcoat pocket was burned. Inside, where his watch had been, there remained only the

ruins. The works were scattered loose, and through the case was a number of jagged holes. Round the edge the melted gold had formed into small globules, while tiny drops were found on the floor.

It will be remembered that in his earlier days Edison killed cockroaches by means of electricity. Since then a rat-trap has been devised, which kills the captured animal, the moment it tugs at the meat used as a bait, to lead it to destruction. Snakes are also destroyed by this means in India. Two wires are laid before the house door, and when the snake crawls over them, its body completes the circuit and an electric shock, which kills the reptile, is the immediate result.

When electricity is produced, it passes away as fast as it can if not retained in some way. Now there are certain substances, such as metals, water, animals, the human body, and the ground, along which the electric current flows with great rapidity. These are called 'conductors. There are also other substances, such as glass, porcelain, silk, wax, indiarubber, and gutta percha, over which it will scarcely flow at all. These are non-conductors.

The plan is therefore to collect the electricity by means of conductors, and then prevent it from getting away by surrounding it with non-conductors, or insulators.

It may not be generally known that the lightning we see during a thunderstorm is nothing but electricity. There is always a good deal of electricity in the air caused by the rubbing of moist air against dry air, by the blowing of the wind, and the turning of water into vapour by the heat of the sun.

When clouds become charged with electricity they rush together. A flash of lightning is seen and the roar of thunder is heard. The lightning is the same thing as a spark from an electrical machine. It takes several forms, and is known as fork, sheet, and ball lightning. When the clouds are near the earth the flash comes straight down, for it has little air to pass through. When it is some distance from the earth it flies from side to side, making its way through the parts of the air, and is zigzag or forked. When the cloud is heavily charged with electricity, it forces its way in the form of a ball. Sheet lightning is the reflection of distant fork lightning, or light discharges of distant clouds.

Now as the lightning passes through the air it leaves behind it an empty space. Instantly air rushes in to fill up the vacancy, and in so doing produces the loud sound which we call thunder. We do not hear the thunder till a short time after we have seen the lightning, because light travels so much quicker than

sound. The nearer the thunder clouds are to us the louder will sound the crash.

Lightning follows the best conductor. The air itself is a bad conductor, so the lightning in its descent to the earth, is attracted by the first object it meets and first strikes the tallest things—spires, chimneys, and trees. It also rushes to the best conducting material in or about the object struck. We therefore provide for this by fitting lightning rods on the highest buildings. These rods are good conductors; they attract the lightning and prevent it from doing any harm by conducting it silently and safely to the ground.

The safest place during a thunderstorm is indoors, away from all draughts, picture frames, and wires. The centre of a room in the middle of a house is safer than an outer room. And lying in an iron bedstead is the safest place of all. It really acts like a metal cage or lightning screen, and the electric fluid may run round it, but not touch anything within the bed. Remember that it always follows the best conductor.

The loss of life from lightning is very large throughout the world. Yet the majority of deaths takes place in level and open places. Trees, villages, and thickly-built towns and cities, have so many projections, that the inhabitants are protected from direct strokes. In one year over two hundred deaths were reported in the

United States, and in seven years over two thousand took place in Russia.

Lightning was first proved to be electricity by an American philosopher, named Benjamin Franklin. He made a kite and fastened to it a pointed iron wire, and to this he tied the string. Then, during a thunderstorm, he flew the kite in the air and drew down the electric current, or in other words he attracted the lightning to his kite. So that it would not pass through his body to the earth, he tied a piece of silk ribbon to the end of the string, and this he held in his hand.

Then, to draw the electricity from the string, he fastened an iron key to it, and found that sparks came from the key just as they do from an electric machine. Franklin's experiment led to the use of lightning rods to protect buildings.

You will now understand how we manage to make use of such a strange and powerful thing as electricity. We do not confine it in the same way as we confine water and steam, but we can generate it, and store it, and conduct it in any way we choose, and so make it serve our purpose.

Electric currents will flow over thousands of miles in the same rapid manner as a flash of lightning, and thus we are able to telegraph long distances in a moment of time. To prevent the electric current from leaving the

wires they are insulated, that is, they are not allowed to touch anything that is a conductor of electricity. Glass is a non-conductor, and is therefore used to support the wires at any point, where they would come in contact with other substances. You may see this on any pole or lightning conductor.

CHAPTER IX.

THE TELEGRAPH.

FROM the time that Edison boomed the daily paper, that gave an account of the battle of Shiloh, until the present day, he has always kept his eye—we may say both eyes—on the electric telegraph. Then, it served him so well that he was forcibly struck with the idea “that the telegraph was the best thing going.” It also led him to fully appreciate the wonders of electrical science.

Nor do we wonder at this, for in using electricity to send messages, man has yoked and tamed for his service one of the swiftest and most subtle of all the forces of Nature, and the final result of this mastery over an element so powerful and so marvellous no man can tell.

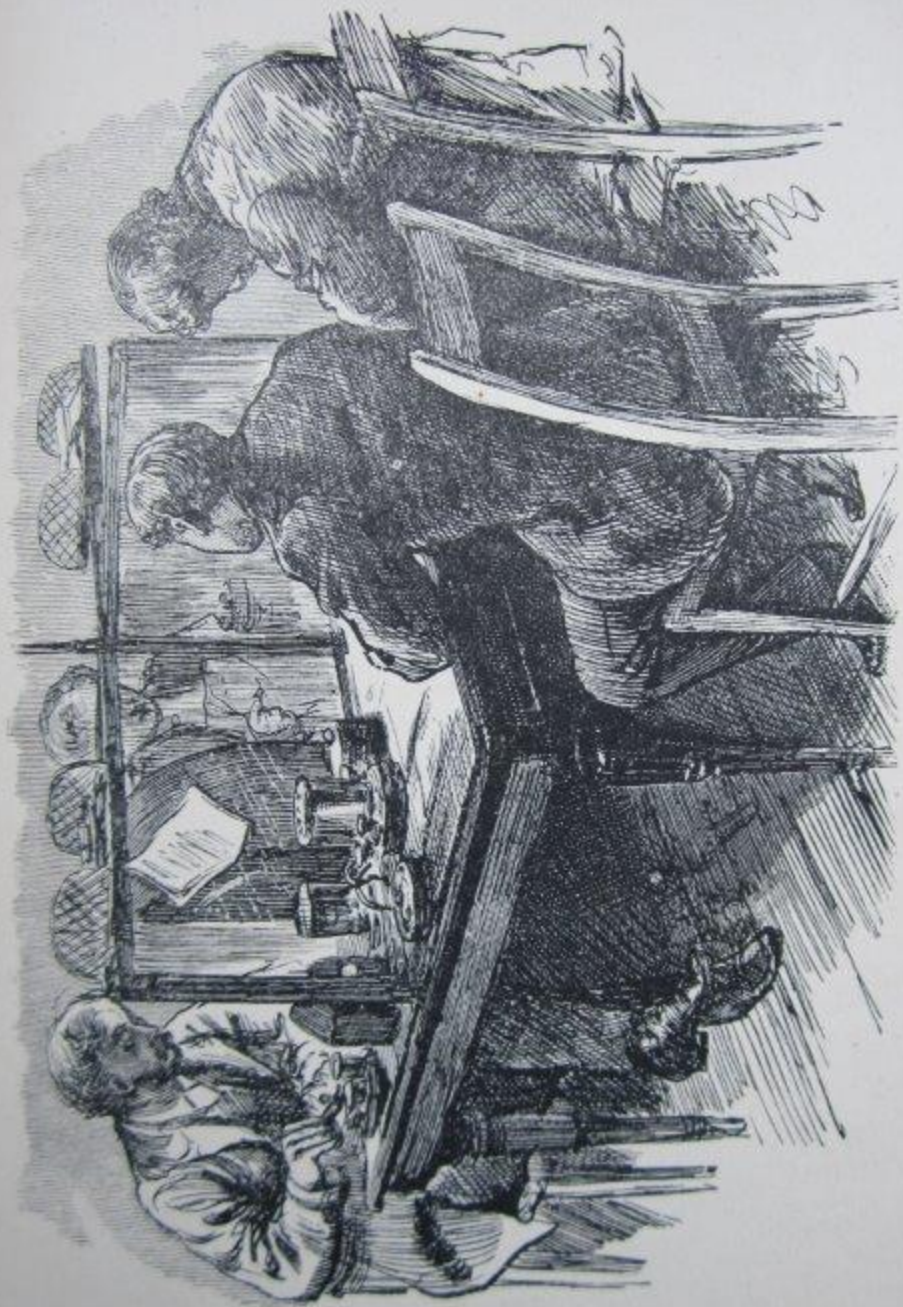
In a recent speech, the Right Honourable W. E. Gladstone said that he had often thought that history would be better divided into compartments, marked off by great discoveries, than into reigns or royal lines.

“Speaking only of those of modern times,” he said, “you would have an epoch marked by the discoveries of gunpowder, of the printing press, and of the steam engine; and those discoveries have had an influence infinitely more powerful, not only upon the large collective destinies, but upon the daily life and experience of a multitude of human beings, than even the careers of conquerors, or devices of the greatest statesmen. In the list the last competitor is the science of electricity. I think the historian of the future will recognise that there has been a larger influence on the destinies of mankind, exercised by this fascinating discovery than even the discovery of the steam engine itself, because it is a discovery that operates so immediately upon the moral and intellectual nature and action of mankind. The electric telegraph has achieved this great result, that it has assembled all mankind upon one great plane, where they can see everything that is done or said, and judge of every policy that is pursued, at the moment the events take place. By the action of the electric telegraph you have combined together almost at one moment, the opinions of the whole of the intelligent world with respect to everything that is passing at the time on the face of the globe. It is a phenomenon to which nothing in the history of our planet presents anything that is equal, and the intensity of its power increases year by year.”

Regarding history from the standpoint of the statesman who said these words, and who is himself one of the greatest makers of history who ever lived, we must number Edison among those epoch-making men, before whose work the doings of kings, and conquerors, and politicians, are but as lights and shadows on the landscape. We have already noticed that Edison did not invent the telegraph, and that the wonderful power of electricity was known before he was born. His improvements, however, have done much to perfect and increase the value of this wonderful invention.

The word telegraph means "far writer," and as its name implies, it is an instrument for sending messages along wires to almost any distance, by means of electricity. It is therefore known as the electric telegraph. At first the users of this system of communication were satisfied to send one message at a time on one wire. But as business increased, and newspapers multiplied, better facilities were required.

Edison's method of sending four separate messages, two in each direction, over a single wire at the same time, was perfected in 1874. The experiments in connection with this invention were carried out at his works at Newark. Then the apparatus was taken to New York, and when finally ready, communications were opened with Boston. The trial proved a success,



From a drawing

FOUR MESSAGES OVER THE SAME WIRE.

[by Harry Furniss]

and the method was adopted in all parts of the country. In one year it saved one telegraph company above £100,000.

He also devised what is called the Harmonic Multiplex Telegraph, which employs musical sounds made by tuning forks and reeds at each end of the line. Each fork or reed responds only to its note or pitch, and by this arrangement Edison has sent sixteen messages at the same time, eight each way.

A still more striking device is that by which it is possible to telegraph from a moving train. We know that on long journeys, where trains run from one to two or more hours without stopping, a plan is used by which the engine can obtain a supply of water from a long, continuous tank placed between the rails. But in that case a connection between the tank and the engine is made for the time being, through which the water is forced.

In some such way a connection has been established between the moving train and the stations. This device is ingenious; but it is scarcely one to satisfy such a miracle-worker as Edison. The marvel of his method is that no extra wire is required, and no such connection takes place.

There is an apparatus in the railway carriage, so arranged that from it the electric current passes

through the air to the wires at the side of the line. Though not easy to explain to anyone who has not studied the telegraph, we may say that the system is neither difficult nor costly, and that it is now largely used. Messages have been sent through the air from the moving train to the wires, a distance of five hundred feet.

There is no doubt that such an invention, fitted up in all express trains, would go far to remove the objections that many people have of being shut up in a moving railway carriage for lengthened periods, and without the power of communicating with the outside world. While in the prevention of accidents and the capture of criminals, it is of the highest value.

The value of the electric telegraph, especially to business men, is beyond all calculation. Its importance, however, may be seen from the following facts. In the United Kingdom there were, in 1890, between seven and eight thousand offices—postal and railway—from which messages could be sent, and two hundred thousand miles of wires. During that year over thirty-six million messages were sent. The largest telegraph office in the world is at the London General Post Office, where over three thousand operators are employed.

In the United States there were more offices, and a greater length of wires, but not quite as many messages.

Then there are cables connecting all parts of the world ; of these, fourteen cross the Atlantic Ocean.

A message, of not more than twelve words, may be sent to any part of the United Kingdom for sixpence, and across the Atlantic on payment of one shilling per word. For one shilling and ninepence per word a message may be sent across the Atlantic, and then across the Continent of North America, to the shores of the Pacific Ocean, a distance of more than five thousand miles.

A message has been sent across the Atlantic to America, and answered in less than a minute ; but this was simply between the office on this side and the office on the other side. There is, however, an instance of a message being sent by cable from New York to London, ordering certain business to be done. Six minutes afterwards a reply was received in New York, intimating that the order had been complied with.

CHAPTER X.

THE TELEPHONE.

Now let us glance at the telephone, which is an instrument for sending sounds a long distance by means of electricity. Edison did not invent this instrument, but here also he showed his ingenuity by his improvements. He also constructed the microphone, which has the power of magnifying sounds in the process of transmission. This is used in connection with the telephone.

The megaphone, which Edison invented, brings distant sounds within hearing without the use of wires. Two funnels, thirty inches wide at the outer end, and narrowing to a small hole, to which tubes are attached for the ears, are used. Persons several miles apart are able to converse with each other by these means.

The aerophone, also invented by Edison, magnifies the ordinary tones of speech two hundred times, and projects the sound to a considerable distance. The

slightest whisper is roared out in such a manner that it can be heard all over the neighbourhood. So far the megaphone and the aerophone have not been used in any practical way.

The telephone, however, like the telegraph, has met with ready acceptance, and is now used almost everywhere. It is beyond all question one of the greatest time-savers ever invented. Without leaving their houses or places of business, two persons, who are hundreds of miles apart, may hold a conversation with each other, with the greatest ease. Nor are they required to employ anyone to assist in any way. They have only to speak and listen.

The telephone has found its way very largely into all the countries of Europe, and all parts of North America. Many of the chief towns in England are connected with London, and London is connected with Paris. In the United States there are lines over a thousand miles in length, and conversations are carried on over this enormous distance.

So far, then, the inventions of Edison, in connection with the telegraph and the telephone, relate rather to improvements in appliances and apparatus, and the perfecting of those already in use, than to the first conception of the original idea. The different purposes to which these two instruments are applied may be briefly stated thus :

The telegraph, or "far-writer," carries messages along wires, and records them by means of symbols; and the telephone, or "far-sounder," carries messages along wires, and makes them heard at a distance.

In the telephone, the twin sister of the telegraph, Edison has made so many improvements and invented so many devices, that it is impossible even to mention them all. Such names as the water telephone, the chemical telephone, and the mercury telephone, suggest some of the means by which varied results have been obtained.

Those who live in towns know how easy and how simply the telephone is now worked for the comfort and convenience of the public. A man may remain in his own house, and without using writing materials or employing a messenger, give all necessary instructions for the conduct of his business, or answer any question as quickly and as easily as if he were in his office. In his office he may at once speak to his wife at home, or to any of the people with whom he does business.

A gentleman was recently sitting in his office, more than one hundred miles from London. Suddenly the bell of his telephone rung, calling his attention to the fact that someone wished to speak to him. He at once replied, and was informed by his London agent that a large buyer from South America had just called, and

RECEIVING MESSAGES AT THE TELEPHONE.



that it was of the utmost importance that he should see him that very day. The question that his agent asked was, "Can you come to London to-day?"

It was eleven o'clock in the morning when he received the message, and at half-past he was in the express for the metropolis. But you may say that the telegraph could have been employed as effectually in this case as the telephone. It could so far as delivering the message from London. But note what happened between eleven and half-past.

First of all, the gentleman was able to reply to his agent as quickly as if they had only been standing a yard apart. He was able, by asking one or two questions, to satisfy himself that his presence in London could not well be dispensed with, and as the man who wished to see him was then with his agent, an appointment was made for that very afternoon.

This done, the gentleman rung up, that is, called the attention of a cab office to send a cab to take him to the station. Then he rung up his own house, to inform his family that he was going to London by the next train, and asked one of them to meet him at the station, with a rug and overcoat. After that he rung up a merchant in the town, with whom he had an engagement, and informed him of his sudden call to London. From another person he obtained information

which he knew that he should require on his arrival. Then he rung up the hotel in the city, where he usually stayed, to secure a bed for the night.

All this was done in a few minutes, without leaving the room, without sending out a single messenger, and at little more than the cost of the shortest telegram. The only extra charge that he would be called on to pay would be for the message to the London hotel. All the messages in his own town were included in the yearly rent he paid for the telephone, and the reply he sent to his agent was included in the charge paid by the agent at the London end. Even supposing the cost of the telephone messages to be more than the telegrams, they would have to be very great to be worth more than the time of a busy man, and in this instance the visit to London affected business transactions of thousands of pounds. The chief objection to the telegraph is the time lost in getting a reply, and this is often considerable when messages have to be carried any distance to and from the telegraph office.

Sermons and other addresses, also concerts and operas, can be enjoyed by means of the telephone, without leaving home. A public speaker or singer may in this way address or sing to an unseen audience, scattered over a wide district, and his voice may be heard at the same time by persons many miles apart.

In America there are telephones arranged on the "put-a-penny-in-the-slot" principle. A coin is inserted, which sets a clock-work apparatus in motion that connects the telephone. It then remains open for a given time to allow a conversation to take place. When the time has expired, the clockwork cuts off the communication, and another coin is needed to restart the machinery and renew the conversation.

The same plan is adopted in Paris, by what is called the Theatrophone Company. On inserting a coin, a person is put in communication with a theatre or concert for a given time. On paying a certain fixed sum, persons are allowed to hear the whole performance.

Telephonic communication may be established under water as well as over land. Some of our lightships are now connected with lifeboat stations in this way. Recently a lifeboat was summoned to assist a stranded vessel. Before the boat was launched a second message arrived saying that the craft had got off into deep water. This saved the hardy crew a night's needless exposure.

Those who have not had the pleasure of holding a conversation by means of the telephone, often ask if it is possible to recognise the voice of the speaker. Certainly, as the following incident will show. A gentleman, who lived out of town, one day lost his dog when he was in the city, and had to return home without him. A short

time after his arrival, he was informed by the telephone that the dog had turned up at a friend's office, where he had called that day.

"Keep Jack," said the gentleman, "till I come to-morrow."

The dog was standing by the city friend during the conversation, and, hearing his name uttered in his master's voice, he began to wag his tail, and look about for the speaker. He then sat down and could scarcely be persuaded to stir from the spot, as if he were expecting his master to step out of the telephone.

How far can the voice be carried by means of the telephone? is also a very interesting question. The distance depends upon the nature of the conductor, and the perfection of the electric current which passes over it. Given all the conditions required, we may say that there would be no limit to the distance over which a telephone would be workable. In the first place, there is no such thing as an absolutely perfect conductor, which offers no resistance to the passage of electricity, and the greater the distance the feebler the current becomes. Then again, there is no such thing as a perfect non-conductor. No matter what materials are used, some of the electricity escapes by the way.

Induction is also another serious barrier to telephonic communication over long distances. That is, all electric

currents are more or less influenced by the currents which are passing over other wires near them. In this country there are so many wires for the telephone, the telegraph, and the electric light, that induction takes place to a very considerable extent. So far, the greatest distance over which conversation has been carried on by means of iron wires, is two hundred and fifty miles, and by a compound wire of steel and copper, a little over one thousand miles.

CHAPTER XI.

THE PHONOGRAPH.

THIS marvellous instrument was discovered by accident in 1878. One day Edison was experimenting with the telephone, when the vibrations of the voice sent the fine steel point into his finger. Accustomed to note everything, however apparently slight or unimportant, the pricking of his finger in this way set him thinking, and the idea occurred to him that if he could find some way of recording the movements of the steel point, and then cause the point to travel over the same surface again, there was no reason why the thing should not talk.

Following up this reasoning by experiment, Edison caused the telephone to work on a strip of telegraph paper, and he found that it recorded letters. He shouted the word "Halloo!" into the mouthpiece of the telephone. Then he ran the steel point back over the marks, and to his great delight he faintly

heard what sounded like an echo of his own voice, "Halloo!"

Here, then, was the first conception of a talking machine or sound writer. Eager to develop the idea and to reduce it to a practical form, the inventor made a rough sketch of a machine which he thought would carry out his ideas. Taking this to his assistants he told them what to do, and what results he expected. "And," says he, "they laughed at me." They knew that their ingenious chief could make machines to do almost anything, but they thought that the line should be drawn somewhere, and they were not prepared to hear one talk. They, however, obeyed his orders, constructed the machine, and the phonograph was the result.

A recent writer who has seen and handled the first machine that ever registered and reproduced human speech, says that "it is a very crude or imperfect affair, and he could but wonder while looking at the simple combination of metal, at the audacity of the man who even expected it to do what it did. Since then the instrument has been improved, and in its new form is rapidly taking the place of shorthand writers. Phonographs are being turned out in large numbers, giving employment to hundreds of workmen.

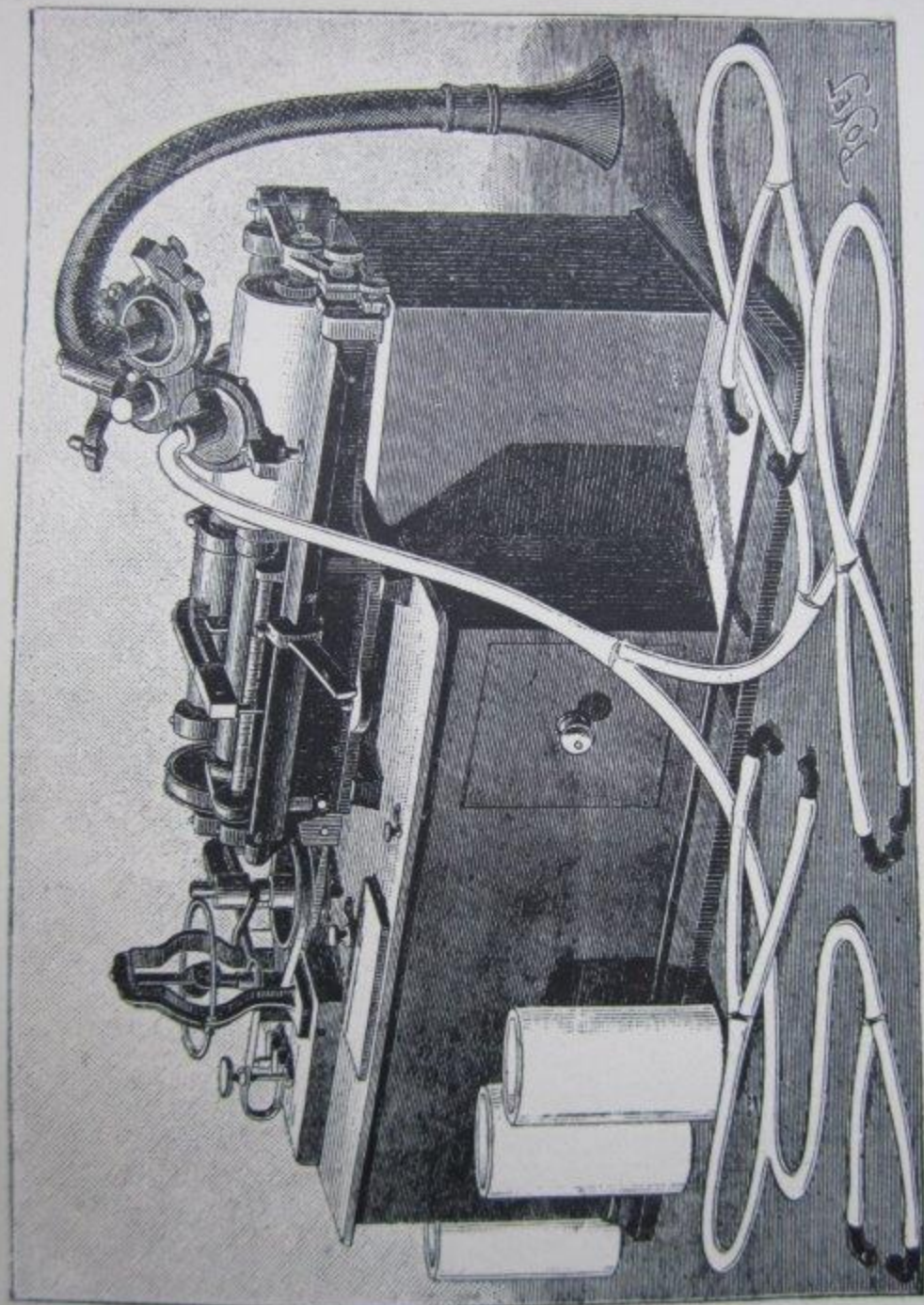
The best way to learn what the phonograph is like

and how it does its work, is to see one and examine it. Nor is this a difficult matter, for the instrument is on view in most of our large towns. It is also one of the attractions at bazaars and exhibitions, where for a small payment, the curious visitor may listen to the story or song which it has to unfold.

We will, however, try to explain the phonograph in a clear and simple manner, and as far as possible, without many technical terms. By reading the description carefully and looking at the picture in the light of it, a good idea may be obtained of "Edison's miracle." In any case it is not difficult to understand the principle on which it works.

The phonograph then is a sound writer. Now all sounds make waves in the air. These sound waves strike the drum of the ear, and make it vibrate or tremble, thus causing the ear to hear the sound.

In the telephone the sound waves make a thin plate of iron vibrate like the drum of the human ear. These vibrations are carried long distances over wires, and the person at the other end hears the very sound which set the iron plate trembling. Now in the phonograph there is a plate just like that in the telephone, which is set trembling by sounds in the same way. But instead of a wire to carry the sounds to a distance as in the telephone, the phonograph has a little instrument which



THE PHONOGRAPH.

writes down all the vibrations or tremblings of the plate.

The most important part of the phonograph, in appearance like a pair of spectacles, is called the spectacle frame. On one side of this frame is the recorder of the sounds, and the other side of the frame is the repeater or reproducer of the sounds.

The recorder is simply a disc, a piece of thin metal about the size of a two-shilling piece, with a needle fixed in the centre of the back, called the recording needle. The repeater is another disc, exactly like the recorder, with this difference, the needle has a ball point and is perfectly smooth, so that it will not cut.

The body of the machine consists of a metal cylinder or roller, over which is fitted a tube of wax. This substance, being firm and yet soft, is suited to receive any impressions made upon it, and retain them in their exact form. A harder substance would not be as easy to work, and a less rigid substance would become wrinkled, puckered, and lose its shape.

The telegraph and the phonograph are worked by means of electricity. The phonograph, however, may be worked by any power—the hand, the foot, water, steam, or electricity. All that the power has to do is to keep the roller turning while a person is speaking.

Now let us imagine that we are about to use the

phonograph. The wax cylinder is placed in position ready to receive the record of our words or of any other sound which we choose to make. We place the spectacle frame so that the recording needle cuts a very little way into the wax. Then we speak, sing, or whistle into a mouthpiece and form sound waves, which strike upon the disc of the recorder and cause it to vibrate or tremble. Then, as a natural consequence, the recording needle vibrates or trembles, and in so doing carves or cuts upon the wax cylinder, certain marks or signs which represent the sound waves. Then the record is made.

All the time that we are speaking into the phonograph the roller is kept moving round and round. The spectacle frame also moves along the roller at the same time, by means of a revolving screw. In this way the record made on the roller has the appearance of a dotted or indented spiral groove, which runs round the roller from end to end.

Having recorded the sounds, how are we to get them repeated to us? This is done in a very simple manner. The spectacle frame is brought back to the place from which it started. The recording needle is thrown out of position and the repeating needle takes its place, which you will remember, is fixed on a disc, and is in all respects like the recording needle, excepting

that the point does not cut. Ear pieces attached to the machine by tubes, are then used instead of the mouthpiece, and the machine is once more set in motion.

What happens? As the roller revolves, the repeating needle passes over the dents made by the recording needle, which cause it to vibrate or tremble. This acts upon the disc and it vibrates, and sets the sound waves in motion, and so reproduces any sound recorded on the roller.

When one cylinder is full it may be taken off and another put in its place. The number of words, however, which can be put on a cylinder, is so large that any one may be truly said to talk by the mile. The cylinders can be kept for any length of time and put back into the machine to reproduce their contents as often as may be wished; or the dents in the wax can be easily pared off by a little knife, which shaves the roller, leaving the surface as smooth as ever, and ready to be used again.

But you may ask, "Of what use is the phonograph?" As a clever invention and as a curiosity, it is beyond question the most marvellous instrument the world has ever seen. But it has also a practical side, for there is scarcely any limit to the purposes to which it may be adapted where sound is in any way used. We have

already indicated some of these uses in a general manner in our description of the machine, we will now go a little more into detail.

The phonograph may be used by all persons whose writing has to be reproduced for others to read. For instance, persons who have a large correspondence may save the expense of a shorthand writer, and speak the contents of their letters into the machine, and the wax cylinders may be sent by post just in the same way as letters. On receipt they have only to be put into another machine to make known their contents; or they may be handed over to clerks to write out what has been recorded on them. An author may, in the same way, speak or dictate his article or the matter for a book just as is now often done to a shorthand writer. Then the matter can either be written out by someone else, or it may be actually set in type by the compositor without one word of it having to be written down. This has actually been done in a London newspaper office.

The phonograph may be used in place of a reader in the following manner:—A good reader may read into the instrument a story, an article, or the contents of a whole book. This can be reproduced at the pleasure of the hearer, when, where, in what portions, and at what rate of speed he chooses. Anyone could thus

have the pleasure of hearing a good story read without the presence of the reader.

An address may be delivered, a sermon may be preached, a song may be sung, or a selection of music played, by one or many instruments into a phonograph. Persons may then sit quietly at home and improve their mind, or enjoy all the pleasures of a concert or an opera. The address, the sermon, the song, and the music, will all sound to the hearers exactly as they were spoken, sung, or played.

The phonograph can be used to teach foreign languages without the presence of the teacher. If the exact pronunciation is once recorded on the cylinder, the learner may produce it and imitate it as often as he chooses, until both ear and tongue have thoroughly mastered it. Travellers could also bring back with them the different dialects of the savage races dwelling in the countries through which they pass.

The phonograph may be used to record the sayings of great men, and after they have passed away we may at pleasure reproduce their own words, in their own voices. Think of the gratification future generations will experience in hearing the words of a Bright, a Gladstone, or a Spurgeon, uttered in the tones of the living man. Then the songs of Sims Reeves and Madame Patti, and the solos of Abbe Liszt and other musicians.

The phonograph may amuse, interest, and even instruct the little ones in the nursery, as they listen to their dolls uttering funny sayings, or making grave remarks in keeping with the characters they represent.

Clocks may also be caused not only to show the time of day, and to strike the hours, but also to announce any given time. They may also be made to remind us of the performance of any duty. The words are impressed on a disc of vulcanised rubber while it is soft, and then attached to the works of the timepiece. In short, we cannot mention all the uses to which this wonderful machine may be applied.

CHAPTER XII.

EDISON'S PHONOGRAPHIC LEVEE.

IN the last chapter we have told the story of the phonograph, and we also described the perfected machine. But our readers must not for one moment suppose that the instrument was produced in its present state in a few days or even months.

The first idea presented itself to the inventor's mind in 1878, and a model was then made. At that early stage Edison spoke with the greatest confidence about the future of his new invention, and the possibilities it contained. But other things of a more pressing nature occupied his attention for a time, and therefore the phonograph was laid aside for future developments.

Several years passed away before he was again able to give it his attention. It is said that the matter was again brought to the front by the remark of a gentleman who said to the inventor,

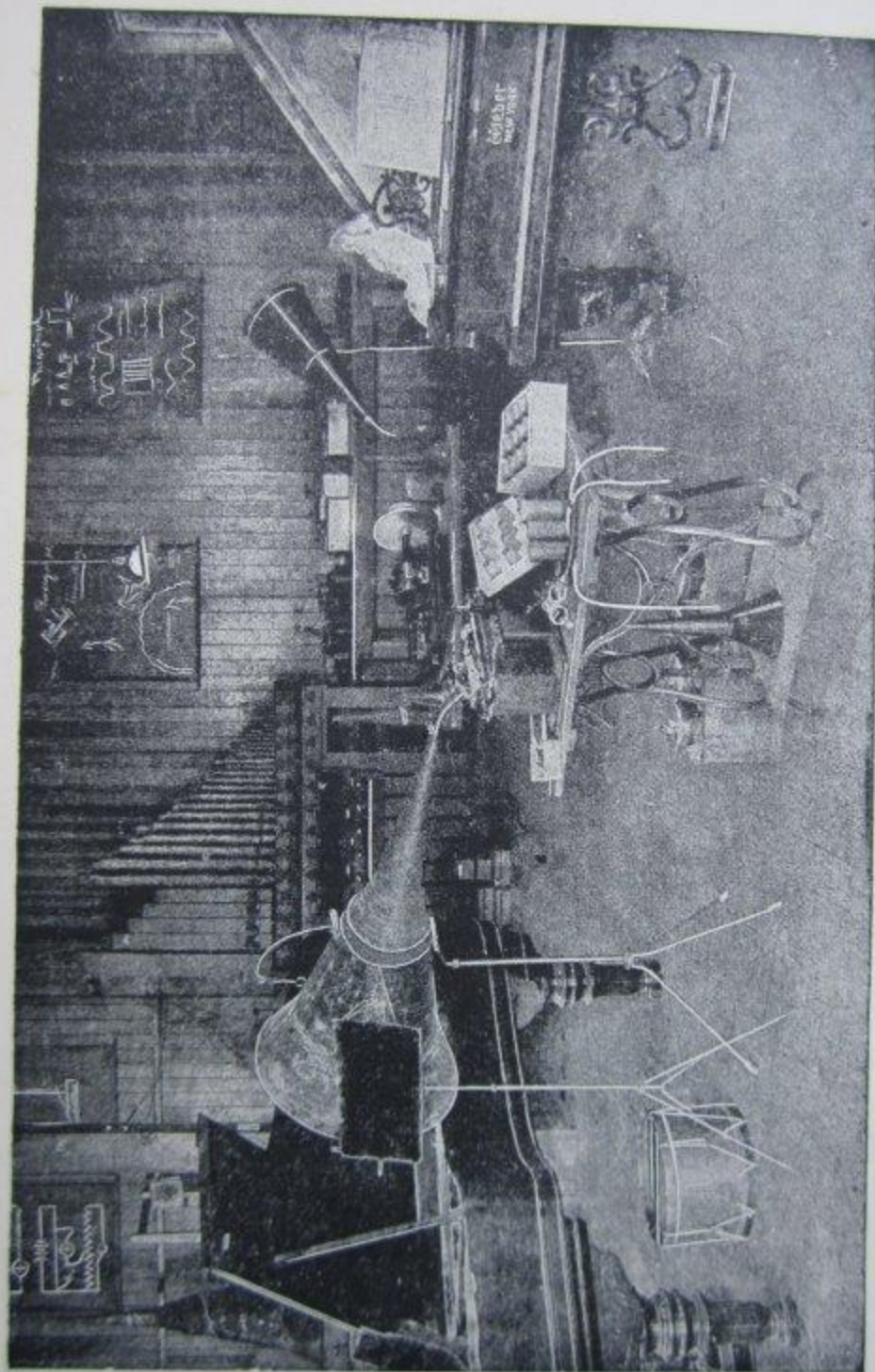
"Now, Edison, you must make something to record these sounds."

When he again took up the phonograph he at once set about experimenting to obtain certain results and to overcome various defects.

Only those who have to do with delicate machines can form any idea how small a thing or how slight an obstruction can make useless the carefully adjusted wheels and springs, which produce or regulate any movement. As an illustration of this we may call to mind instances where watches have resisted all their owner's little attentions, and yet the skilled workman has put them right in a moment. "It was only a trifle," he may have said. A trifle certainly in his estimation, but to the owner, it was watch or no watch.

If Edison had been willing to turn out an imperfect machine, he might have saved himself an immense amount of labour. But it was not enough for him to make a machine, which merely recorded sounds that when heard could be understood. His aim was to make an instrument which would give back the words of the speaker, with all the finer shades of the human voice.

For about half a year he spent fifteen to twenty hours a day before he could induce the stubborn machine to repeat the letter "s." Day after day, week after week, and month after month, he spoke the word "spezia" into the instrument. Thousands of times he gave it the correct word, and as often it came back



EDISON'S LABORATORY—THE PHONOGRAPH ROOM.

beheaded in the form of "pezia." It could not pronounce the initial letter. This lisp might have been tolerated in the infant machine, but it could not be endured as it emerged from the period of babyhood. The inventor therefore persisted in correcting it, by making such changes and adaptations as were suggested by his fertile brain. Nor did he stay his hand until he considered that its enunciation of "s" was perfect.

Then, again, he was not satisfied to send as his representative to all parts of the world, an instrument so imperfectly educated as to drop its "h's" in conversation. This, therefore, entailed upon its author long and tedious experiments, until that difficulty was overcome.

Nursery rhymes were freely used and repeated so often in varying tones, that a stranger, visiting the workshop, and hearing the lines so dear to childhood,

" Mary had a little lamb,
A little lamb, a little lamb,"

might have supposed that he had accidentally stumbled into an infant school, instead of the laboratory of the world famous inventor.

However, the work went on, and one difficulty after another was overcome, until at length the demands of Edison were met. Then the machine was sent out to

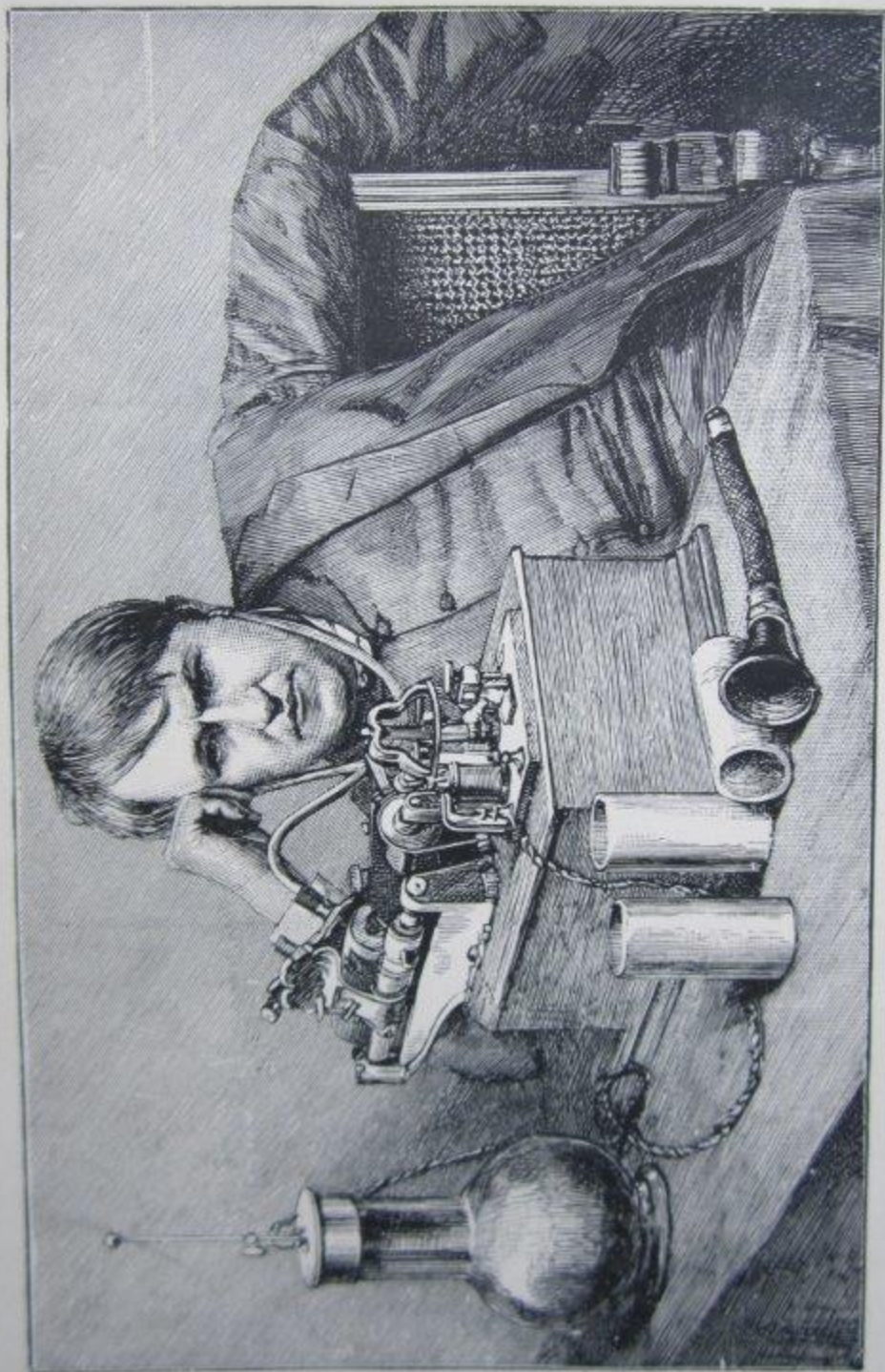
literally "speak for itself." That it has spoken to some purpose is shown in the public interest, which it has awakened, and the demand created for it.

In 1888 the "new phonograph," as it was called, was sent to England and exhibited at the Crystal Palace, London, by Colonel Gouraud, Edison's agent in this country. The colonel had also received from his chief a phonogram, as a letter on a cylinder is called. He therefore invited a number of friends to his house "to meet Edison."

When the company was assembled the phonogram was placed in the phonograph, and all present had the pleasure of hearing the inventor read his own letter.

The manner in which the instrument reproduced its maker's voice was remarkable. It seemed as if the speaker was really in their midst. Anyone who had heard him speak would at once have recognised the tones of his voice, as they fell from the phonograph.

Then the guests were treated to an address from the phonograph itself, which of course had been spoken into it, and in which the instrument was made to attribute its powers of speech to the "rare genius, incomparable patience, and indefatigable industry," of Edison. In his name it thanked the members of the London press for the favourable reception it had received.



EDISON RECEIVING THE FIRST PHONOGRAPHIC MESSAGE FROM ENGLAND.



This was followed by a poem, composed by Dr. Nelson Powers, of Piermont on the Hudson, entitled "The Phonograph's Salutation." Breaking into verse, the instrument said,

"I am a tomb, a paradise, a shrine,
An angel, prophet, slave, immortal friend,
My living records, in their native tone,
Convict the knave and disputations end.
Hail! English shores, and homes and marts of peace,
New trophies, Gouraud, yet are to be won,
May 'sweetness, light,' and brotherhood increase,
I am the latest born of Edison."

This poetical effusion was followed by a varied and interesting programme of music, in which almost every instrument had a place. The cornet, the piano, the violin, and the flute in turn gave forth their sweet strains to the wonder and delight of the listeners. Then those present had the pleasure of "speaking back." On a fresh cylinder they were permitted to record the messages they wished to send the man who had invented the magical instrument before them.

Colonel Gouraud was, for some time after this, busily engaged in securing contributions from the most important persons on this side of the Atlantic. In these efforts he was very successful, for who could

refuse to have their speech recorded, that the creator of the machine which made it possible, might in this way hold communion with the great ones of the earth, for was he not, and still is, one of the monarchs of the human race?

One day Edison held a levée at his house in America. His friends in the New World gathered in the flesh, to meet his admirers in the Old World, who had sent the record of their voices to speak for them. No better evidence of the importance of the instrument could have been given, than the interest which it had aroused in the minds of so many famous persons. From Victoria, Queen and Empress, down to the poet of the Shah of Persia, all ranks and professions were presented. But the Shah himself could not be induced to address himself to a wax roller.

Queen Victoria sent a kind and encouraging letter to the inventor. The King of Greece expressed his regret that the phonograph was not in existence in the days of Homer. The King, Queen, and Crown Prince of Italy spoke.

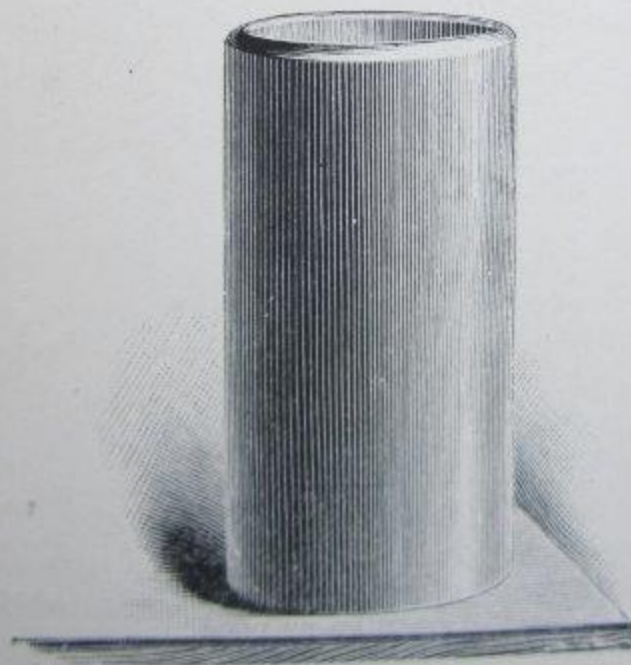
"I am delighted with this instrument," said the Princess of Wales.

"Yes, most wonderful, most marvellous," the Prince struck in.

"I can add nothing to that which their Royal Highnesses have just spoken," said Lord Salisbury.

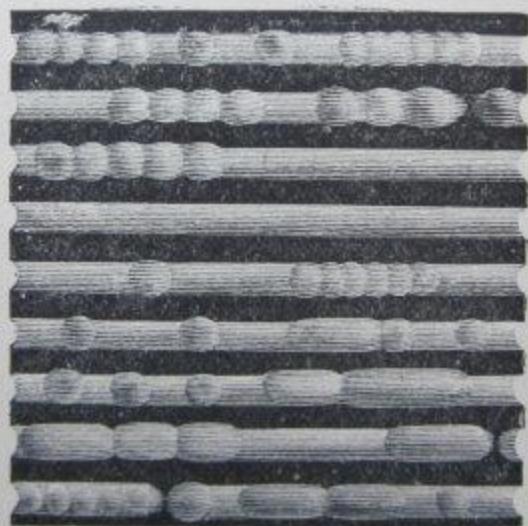
Henry Irving and other actors spoke in approving terms, and said "a piece" into the instrument. Mr. and Mrs. Bancroft both contributed a recitation. Greetings were also sent from Lord Armstrong, Lord Rayleigh, Lord Kelvin, Sir Morell Mackenzie, the Earl of Aberdeen, and many other distinguished men.

Tennyson and Browning's voices seemed to rise from their graves. Since they had spoken the words they had been laid side by side in the Poets' Corner in Westminster Abbey. Tennyson began by explaining



THE WAX CYLINDER OR PHONOGRAM (HALF ACTUAL SIZE),
BEARING THE RECORD OF WORDS SPOKEN BY BROWNING,
APRIL 7TH, 1889.

that he could never remember a line of his poems. He begged, therefore, that he might read something. So he read his "Ode to Wellington." Browning started out bravely to recite his own poem, "How they brought the news from Ghent to Aix," but his memory failed him once or twice. The "hums," and "haws," and the "Oh, I can't remember!" thus provoked from Browning, were faithfully dealt with by the phonograph.



A MICROSCOPICAL ENLARGEMENT—400 TIMES MAGNIFIED—OF PART OF THE WAX CYLINDER OR PHONOGRAM, SHOWING THE INDENTATIONS CAUSED BY BROWNING'S VOICE.

Cardinal Manning's voice was also heard, though he, too, like Tennyson and Browning, had passed into the

silent grave since the words to which they were listening had been spoken.

"Send me Mr. Gladstone's voice," wrote Edison to Colonel Gouraud. And in response to that request the silvery voice of the grand old man eloquent had been sent. Those of us who have sat or stood spellbound in closely-packed rooms, suffering discomforts to which we had become unconscious while the silvery tones of the greatest orator of the day fell on our enraptured ears, can form some idea of the keen enjoyment and gratification Edison's guests must have experienced, as they listened to the voice of the man of whom they had heard so much.

"I am profoundly indebted to you," said the aged statesman, "for, not the entertainment only, but the instruction and the marvels of one of the most remarkable evenings which it has been my privilege to enjoy. Your great country is leading the way in the important work of invention. Heartily do we wish it well, and to you as one of its greatest celebrities, allow me to offer my hearty good wishes and earnest prayers that you may long live to witness its triumphs in all that appertains to the well-being of mankind."

The guests of that evening had the pleasure of listening to Handel's "Israel in Egypt," as it had been rendered by four thousand voices, with the instrumental

accompaniments of the huge organ and mammoth orchestra, at the Handel Festival of 1888.

Edison must have felt repaid for all his labours, as one after another the men and women, whose names are "household words," contributed their meed of praise, or honoured his instrument with their words, that they might in some way show their appreciation of his work.

CHAPTER XIII.

MORE ABOUT THE PHONOGRAPH.

THE Edison Phonograph Toy Company was established in 1887, to supply the demand for talking dolls, and for animals that could utter the various cries of the living creatures they represented. The skill which had already been applied to playthings of this kind, only required this device to make them as real as figures can ever be.

We know the delight awakened by the dolls which open and shut their eyes, and which when squeezed give forth a sound. But the power to utter words and sentences was denied them, until Edison waved his magic wand and gave them the gift of speech. Nor does it lessen the enjoyment of our little ones to know beforehand exactly what their favourite doll will say.

The first dolls that could speak were sent to the young Queen of Holland, who was delighted with a gift, that even the wealth and power of royalty could not command without the assistance of genius.

The demand for dolls and animals that could speak and utter sounds has been enormous, though the price was necessarily high. To supply Europe, factories have been established on this side of the Atlantic, in which the bodies of the dolls and the animals are made. The phonographic works are then imported from Edison's factory in America.

An exhibition is the best place, however, to see and enjoy the phonograph at work. At Paris, in 1889, it is said that not less than thirty thousand persons were daily attracted by the marvellous instrument. Most of the visitors had to be satisfied to listen, and a most varied programme was provided for their delectation.

But the opportunity of recording the voices of many distinguished persons, and the languages of numerous races and tribes, was not lost. Princes and presidents, statesmen and soldiers, musicians and scientists, travellers and explorers, spoke and were duly taken down by the recorder, which is no respecter of persons.

Then came the men of other lands, who, having spoken into the American phonograph, found that it repeated their words in their tongue. "Never before was such a collection of the languages of the whole world made!"

Buffalo Bill was present with some of his Indian braves, who were at that time performing in the Wild

West show. Red Shirt, a Sioux chief, in response to an invitation to speak into the machine, at once obliged the company. Then he placed the receivers to his ears and listened. To his astonishment and alarm his own words came back as he had spoken them. Down went the tubes, and the terrified red man sprang back from the instrument. Neither he nor any of his Indian friends could be again induced to go near the thing that could speak. It contained the voice of the Great Spirit.

De Brazza, the famous African explorer, was also there with a number of natives from various tribes. They too had their speech recorded. Among these persons were some who spoke a language which up to that time had never been written down. The phonograph would be invaluable to Europeans who made contracts with natives, whose language has not been reduced to writing. The want of a permanent record to appeal to after a lapse of time has often been a source of trouble. The phonograph would tell the dusky trader what he had agreed to do, and repeat the conditions in his own voice.

Edison was very fond of joking, and his numberless inventions and contrivances lend themselves to all sorts of surprises, for which his unsuspecting visitors are not prepared. One night a guest was shown to his comfortable chamber, and left to sleep the sleep of the just.

He was in the land of dreams, and totally unconscious of his surroundings, when a hollow voice rang through the room, and the terrified guest heard the words—

“Midnight has struck! Prepare to meet thy God!”

If the startled visitor had been lodged in some old castle, which legend peopled with persons long since dead, he could not have rushed with greater speed from the awful voice.

But his terror was soon dispelled by his fun-loving host, who, expecting what had happened, came forward and said:

“Don’t be scared, old man; it’s nothing but the clock.”

Many stories are told from time to time about the phonograph, and they will multiply as the instrument becomes more widely known and more freely used. Here is one which shows a use not contemplated by the inventor. Recently a man was suddenly afflicted with paralysis. There was no hope of his recovery, and he was very much concerned to think that he had not made his will. His hands were powerless to hold the pen, but he could speak. A phonograph was brought, and the dying man spoke what he would have written, and left his will recorded on the cylinder. How far such a disposition of property was legal we do not know, but surely it would be as easy to prove a man’s voice as his handwriting.

Embalming the living voice and reproducing it after death is both interesting and pathetic. This was illustrated at the funeral of an American singer. When she had been laid in the grave, her friends assembled to hear her favourite hymn, "Nearer my God to Thee." She had sung it into the instrument a few weeks before she died.

One of the latest stories of the "sound writer" is told by Colonel Gouraud. He says:

"One of Mr. Edison's assistants, being some distance from home, was accustomed to communicate with his family by the assistance of the phonograph. He spoke his thoughts into the phonograph, took out the wax cylinder on which his words were impressed, and posted it home. On its arrival it was placed in the phonograph, the machine set revolving, and the message came forth. The absentee had a favourite dog to which he was much attached. In one of his phonograms he sent his love to the dog, finishing with a whistle. The dog was lying quietly on the hearth while the message was being read, but when the whistle came forth he jumped up, bounding all over the room and out at the door to look for the master, whose signal they had heard."

We have heard enough to show that all sounds are alike faithfully recorded by the phonograph. Nor could it be otherwise, seeing that the record consists of

a phonogram of the sound waves. No sound is so low that it cannot be written down, and none so loud that it is beyond the compass of the instrument. Even the mighty roar of Niagara Falls has been recorded, and is daily produced far away from the spot where the great river leaps over massive cliffs.

CHAPTER XIV.

THE ELECTRIC LIGHT.

AND now we have to deal with another modern wonder, which Edison did not invent, but as it is in the direct product of electricity, it has come under the marvellous influence of the nineteenth century "Wizard." This is the electric light. The phonograph is perhaps the most startling of Edison's inventions, and the one that gives the most unexpected results. But the electric light is, beyond all question, the beginning of a new order of things in illuminating.

Sir Humphrey Davy, the inventor of the miners' safety lamp, which, however, did not contain the electric light, was the first to call the attention of the world to this means of illumination, in 1810. It was not then put to any practical use on account of the great expense and the numerous difficulties which attended its production.

From time to time improvements were made and new schemes devised, until in 1844, the Place de la Concorde, Paris, was illuminated by the electric light.

Before we proceed to describe the part that Edison has played in lighting up the world with one of the brightest illuminants that has yet been discovered, we will explain how light is produced by electricity.

The electric current is sent along two wires, one positive and one negative, which meet at a certain point where the light is wanted. If the two wires were joined and the thickness was maintained throughout, there would be no light; but either they are brought within an inch of each other without touching, or they are joined by means of a thin thread or wire. Now, when the strong electric current comes to the place where it is interrupted, it leaps across the gap or struggles round the thin thread or wire. In doing this it produces the bright, white heat, which we call the electric gas.

The first plan is that of keeping the two wires separate. At the end of each wire a stick of carbon is attached, and as the electric current jumps across from carbon point to carbon point, the two points become white with heat, and an arc of great brilliance is formed. This is called the arc light. The carbon is usually made of powdered coke formed into a paste and baked hard.

The arc light is very intense; but the chief disadvantage in its use is the change that takes place in the carbon points. The electric fluid not only jumps across

the gap, but it also tears off the particles, or minute grains of one point, and carries them to the other. Thus one carbon becomes more pointed, and the other carbon hollows out like a cup.

Now, as this change causes the distance between the two points to widen, the arc of light lengthens, and if they are not pushed back again the light will go out, as the current will not continue to pass from point to point. Arc lamps, therefore, require some device to keep the carbon points at the right distance. This makes the system more expensive to set up and maintain. The brilliance of the light is also too great for indoor use, except in large buildings.

In 1877, before the invention of the phonograph, Edison began to seriously consider the defects of electric lighting. Then he was engrossed for a time with the talking machine; but when that was finished, he turned again to the light question, and succeeded in inventing a new lamp.

Instead of leaving the ends of the wires apart and using carbon points, he decided to join the two ends by means of thin wire, or some kind of thread-like substance, called a filament, which would not be easily consumed. He then enclosed the filament inside a glass globe, from which the air had been as nearly as possible exhausted.

Edison's first difficulty was to find the best material of which to make the filament, or thread. On the 16th of October, he commenced a series of experiments, and, assisted by Batchelor, worked on day and night until the 21st, when, after repeated failures, a lamp was completed and lighted. Then the two men went to bed.

When they awoke it was still burning, and the filament did not seem to be affected by the heat. At the end of several days he increased the electric current to obtain a more powerful light. This continued for two days, and then the filament was destroyed.

In the meantime filaments were made of every likely substance, and were tested one after another. At length Edison remembered that the great traveller, Humboldt, had described a certain kind of bamboo, which grew on the banks of the Amazon in South America. He therefore sent one man to China and Japan, another to South America, and a third to India and Ceylon, to bring home specimens answering to his description.

One of these travellers was often filled with surprise to find that his employer's name was known in all parts of the world. In Cairo he asked a donkey boy what he knew about several important persons, but received no reply. When, however, Edison's name was mentioned, the lad at once pointed to the electric light in front of the hotel.

Edison's experiments were so far successful, that in 1881 he completed a lamp which burned continuously for over 1,500 hours. This was the first incandescent lamp which at all answered the inventor's requirements. The word incandescent simply means to burn with a white or glowing heat.

But you may ask, how is it that a thin thread or fibre or other material will withstand the action of the electric current for so long a time, when a thick rod of carbon is consumed in ten or twelve hours? Because the thin thread is burnt inside a glass globe, which contains little or no air. There is no oxygen present to combine with it and form a gas, which would be invisible. It may therefore be heated until it breaks from some cause or other.

Edison's incandescent lamp was exhibited at the Paris Electrical Exposition, when the inventor was awarded five gold medals and a diploma of honour. The cable message which announced the awards, said,

"This is complete success, the Congress having nothing higher to give you."

The soft, subdued, yet brilliant light of the incandescent lamp, is a happy blending of mellowness and strength, which lends itself much more readily to the lighting up of a house than the lamp. It is also better under control and more regular. The use of the

electric light not only increases the illumination, but there is a great improvement in the atmosphere of the room in which it is burned. The air is not affected as when gas is burned. It remains cool, pure, and wholesome.

In 1892 the Albert Medal, which was instituted many years ago in honour of Prince Albert, was awarded to Edison by the Society of Arts. The Prince of Wales, the president of the society, sent a letter with the medal, in which he said,

"It is a source of satisfaction to me that the last name on this distinguished list should be that of one who has done so much for the advancement of science as yourself."

The demand for incandescent lamps became so great that it was met with difficulty, and various works were called into existence employing a large number of workmen. In 1891 more than 1,300,000 of Edison's lamps were in use, and the principle had been applied in a variety of forms.

It is impossible to mention all the uses to which the electric light is put. Nor need we indicate when the arc light is used, or when the incandescent light is most suitable. As a rule, the arc light is confined to outdoor work, lighthouses, and other places where great illuminating power is necessary. The incandescent light is

preferred for houses, and where a handy portable lamp is wanted.

One of the most powerful lamps in the world is used in the lighthouse at St. Catherine's Point, on the Isle of Wight. It is said to be equal to 6,000,000 candles. A recent experiment at Portsmouth showed that an electric light of sixteen-candle power could be seen from a greater distance than an oil lamp of fifty-candle power. It is therefore much superior to oil for ship's lights.

The main streets of many of our large towns, railway stations, public works, and numerous places of business are lighted by electricity. In this respect America is far ahead of us, and Paris is said to be the best lighted city in the world. We have certainly been much slower than our neighbours in taking advantage of this great benefactor.

Street lamps may be turned on and off by clockwork. It is only necessary to have them all connected by a wire to a clock, which is set at a certain time like an alarm clock. Then the machinery connects or disconnects the wires, and turns on or turns off the electric current as the case may be.

The search light is a very powerful form of the electric light, and can be used to throw a most intense light round about, within a given area. It is of the

greatest use to war-ships at sea, as one flash would reveal the presence of an enemy. Some idea may be formed of its wonderful brilliance from a test that was employed at Plymouth Sound. Two vessels were sent out at night. As they returned, the search light was suddenly flashed on them, and in a moment an instantaneous photograph was taken.

Electric lamps can be carried about like oil lamps. They require to be charged with electricity from time to time. That, however, is no bar to their usefulness. We have no light that we can carry, which does not require replenishing, whether it be a candle or oil. These small lamps have one great advantage. They are lighted without matches, and can be carried in any position, for there is nothing to spill.

Lamps of this kind are fixed up in railway carriages, and for a penny you may have a light all to yourself as you are carried on to your station. There are also piano lamps, cycle lamps, oven lamps, to see inside the oven where the bread is baking, walking sticks which contain lamps, drivers' lamps, miners' safety lamps, and many others.

A portable electric lamp for reading in trains can be easily carried in an ordinary hand bag. The battery remains in the bag, and the lamp hooks into the reader's button hole. The lamp is connected with the

battery by means of a length of wire encased in silk. Twelve hours' light only costs a few pence.

The new miners' safety lamp is in a very handy form, and gives a light of one-candle power for over eight hours at a cost of about threepence. The weight of the lamp is four pounds, and when the electricity is exhausted it can be replenished in two minutes. This new lamp is as easily managed as an ordinary safety lamp.

Electricity has been used by medical men for some time; but recently the electric light has been employed by them in a very novel fashion. By its means they are actually able to light up the interior of the body, and see the inside of their patients. A rubber tube, with a small glass bulb at the end, is passed down the throat into the stomach. The bulb is a tiny incandescent lamp, and the wires are in the tube. Then the electric current is turned on, and the inside of the stomach can be seen through the front wall of the body. An electric lamp will also show the position of a needle which may have been run into the hand. There is also a lamp which the surgeon can fix on his forehead, to throw a strong light on any part where it is needed during an operation.

Running streams are largely used to supply the power required to generate electricity. Niagara Falls is

used in this way, A water wheel works the dynamo or electric machine, and the current is conveyed by wires to the place where the light is wanted. In this way the cost of production is much smaller than where gas or steam is used.

CHAPTER XV.

THE SECRET OF HIS SUCCESS.

As Edison's inventions multiplied, and the demand for his machines grew, he found that his laboratory at Menlo Park was too small ; he therefore erected a much larger one at Orange, New Jersey. The works are surrounded by a high wall, and at the gate the curious visitors may read the following inscription :—" Mr. Edison, in justice to his work, is compelled to deny absolutely all personal interviews. No permits can be issued to visitors to enter these premises."

The gatekeepers are evidently men who know how to obey their instructions. On one occasion a new man had been appointed to this responsible post, and absolutely refused to allow his master to enter until he was identified by one of the men.

In this new laboratory everything that experience can suggest, genius devise, and money purchase, is provided for the use of the inventor and his assistants.

The library contains over 40,000 volumes of works of reference on every phase of science. Stones and minerals, gems and ores, are displayed in every form and variety of colour.

The storeroom is a collection of everything under the sun that can in any way assist in carrying out Edison's experiments. The animal, the mineral, and the vegetable world have been freely drawn upon to contribute their various products to aid the great magician in his work. Every trade and industry is represented by manufactured goods, tools, instruments, machines, or other useful appliances. In short it is a draper's, grocer's, drug, ironmonger's, glass, chandler's, oil, paper, rubber, leather, grain, hardware, chemical, and leather shop all in one; and there is not any article known to civilized man, from a bootjack to a locomotive, the materials entering into the manufacture of which, could not be furnished from this storeroom.

In other rooms there is a bewildering collection of all kinds of machinery used in the various operations, the instruments supplied by the inventor in different stages of construction, and the patterns and models which guide the men in carrying out the ideas of their employer.

Certain buildings are devoted to photographic work, for Edison has now called this art to his aid, and added

another "miracle" to his ever lengthening list. This is known as the kinetograph, which is described as "the marriage of the phonograph with camera—the union in one instrument of sound and sight."

Edison's intention was to do for the eye what the phonograph does for the ear, and by combining the two record all motion and sound simultaneously. The first idea was suggested to him by the zoetrope, or wheel of life. By persevering with his idea he has at length succeeded, and nothing more natural can possibly be devised. The eye sees and the ear hears all that were done and said by the performer, when the double record was taken by camera and photograph. The organ grinder turns the handle of his instrument, the tune is heard, and the monkey does its part true to life. The actor or the singer, with all their movements and gestures, speak and sing as if they were actually on the stage.

This latest marvel is produced by means of a series of instantaneous photographs, which follow each other in such rapid succession that no gesture, however slight, not even an expression of the face or a glance of the eye is lost to the observer. They are, in fact, one continuous picture of motion. Edison is able to take 2,760 photographs in a minute, and thus reproduce all that goes on while the machine is in operation.

After the impressions are recorded any number of duplicates can be struck off, and the machine, with its varied sights and sounds, will reproduce at any time the wonders it contains.

Edison's home in New Jersey is only a few minutes walk from his famous laboratory. It is a large and spacious dwelling, called "Glenmot," built of brick and stone, and surrounded by well-kept grounds. Here the newsboy of thirty years ago lives a busy and happy life, dividing his attention between his wonderful workshop and his pleasant home. He is the father of five children—two daughters and three sons. The mother of his three elder children died some years ago. His second wife is the daughter of Mr. Lewis Miller, of Chataugua, who is both an inventor and a millionaire. Like her husband, Mrs. Edison is of a retiring disposition, and they prefer the quiet pleasures of their home to the bustle and fatigue of society and public life.

It is gratifying to know that Edison, one of the greatest scientists, and certainly the greatest inventor of the day, is not among those who have found it impossible to harmonise scientific facts with a belief in the existence of an intelligent Creator and a personal God. On the contrary, when directly questioned on this subject, Edison replied that he not only

believed in the existence of God, but he was persuaded that this great truth could almost be proved from chemistry. Further, on another occasion, he declared that no one could "be brought into close contact with the mysteries of Nature, or make a study of chemistry, without being convinced that behind it all there is Supreme intelligence."

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